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The Significance of the Engineering Institute of Canada

OF very important significance is the announcement contained in the Contract Record of December 26, of the change in the name of the Canadian Society of Civil Engineers. The acceptance by the members at large of this recommendation of the Commitee on Society Affairs is a foregone conclusion, so that early this year we may expect to see the Canadian Society of Civil Engineers, as such, a thing of the past. Not that it will have passed out of existence or lose the power it has gained through long years of struggle for recognition, but it will be transformed from a force of limited possibilities to a weapon of unbounded potentialities. The alteration in name is no mere change of dress; it signifies an entire revision of character, such as comports with the dignity and importance of the engineering profession. To recast the whole structure of the society has required much fitting of cloth, but we believe the result is such as will appeal to all who have the uplift of the profession at heart.

As the "Engineering Institute of Canada," the Canadian Society of Civil Engineers will accomplish, we trust, in full measure, the aim and dream of all worthy engineers—the unity and fellowship of the entire profession. Engineers are just engineers, whether they be civil, mechanical, electrical, chemical or what not, and in making adequate provision for the incorporation of all these on the same footing, the Engineering Institute of Canada is giving a broader meaning to the work and accomplishments of the engineer.

An auspicious instance of such unity was actuated a month ago when the great American Society of Civil Engineers joined its sister national engineering bodies in a joint home in the Engineering Societies' Building, New York. So impressive and suggestive were the proceedings on this occasion that we cannot refrain from quoting, in part, from the addresses. "Let us organize," said Mr. W. L. Saunders, past-president of the American Institute of Mining Engineers, "for in organization there is the secret of strength, the basis of influence and the opportunity for power." Mr. G. H. Pegram, president of the American Society of Civil Engineers, stated that "there is a great awakening among engineers as to the necessity of co-operative action for service to the country and to the advancement of the profession. . . . . It is not surprising that while other classes of the community have been organized for concerted action in their several lines, the engineers have been divided into a number of groups determined by the technical differences in the character of their work. While for scientific progress this must go forward in an ever-increasing degree, for economic progress there must be unity of effort. . . . The unity which we celebrate is not a step to meet a temporary need, nor the result of a happy thought; it is an answer to a nation-wide call on engineers to get together. Engineers feel that they have not received just public recognition." The keynote of the whole is contained in Professor Swain's statement: "The engineering profession is one profession—not many."

A like spirit is being manifested in the developments that promise to take place in the Canadian Society of Civil Engineers. Its amended organization makes substantial provision for a full representation of all engineers whatever may be their field of endeavor. Who can say that the engineering profession should be sectarian? For particular purposes, maybe, but not for economic progress and the general advancement of the profession—an avowed purpose of the Canadian Society of Civil Engineers. The change in name is just a measure that will make this purpose more self-evident and supply the answer to those critics who have argued that the Canadian Society of Civil Engineers was too close and narrow a body.

Western Cities Need Buildings

IN response to a request for information on the building situation in Winnipeg, the Contract Record has received the following letter from W. P. Alsip, president of the Alsip Brick, Tile & Lumber Company, Limited:

Last October C. H. Enderton & Company held an auction sale of property in Crescentwood, the best residential district in Winnipeg. At this sale the aver-

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age price was about one-third of the price that lots were held at, and sold for, up to 1914. An auction sale of this property, if held in 1912 or 1913, would, no doubt, have realized C. H. Enderton & Company double the amount. This sale has established a new value on residential lots throughout the city, which, to illustrate my contentions, I will say is 50 per cent. less than the pre-war price.

Take a lot valued at $6,000 in 1913 with a house built before the war at a cost of $12,000. This would make the total cost of such a home $18,000. A similar lot today can be purchased at $3,000 or less and a duplicate of the house will cost about $16,000, making the house, if erected now, cost $19,000, 5½ per cent. or $1,000 in excess of the pre-war cost.

Many pieces of property can be purchased for one-third their 1913 value, and a home erected in 1918 on such a lot would cost the same as if built at pre-war prices.

There was a falling off in population in the city of Winnipeg during 1914 and 1915, when building operations were suspended and many workmen were thrown out of employment, some of whom joined the army and others were forced to leave the city. The city will have made up for the decrease in population and show some gain at the end of 1917. Further, it does not hold the large floating population, which were housed in hotels and rooming houses, many of whom were employed on public improvements and allied trades in the building of the city, for which there was $20,000,000 worth of permits issued in 1913. The great army of men used in the manufacture, distribution, fabrication and erection of brick, cement, plaster, lumber, sash and doors, builders' supplies, steel and iron, etc., to complete the undertaking brought about by the expenditure of the $20,000,000 have been reduced to about 15 per cent. of the number so employed in 1912 and 1913. The other 85 per cent. of these men have taken up other occupations in the city, enlisted, or have left for other points.

We had less men employed in building in Winnipeg in 1917 than the increase in population requires to house and care for them. The result is the filling up of all the apartment blocks and many of the dwellings. Rents in apartments last fall were advanced to about the rate charged in 1912 and 1913. There has been an advance in rents for dwellings, but the supply in most districts is still up to the demand. If more apartments and dwellings are not built in 1918, our increase in population will find all our apartments and dwellings occupied and rents at or about the normal rate. Rents for apartments will, without doubt, be advanced again next fall, in the hope of reimbursing the owners for the loss sustained in 1914-15-16, when there were so many suites vacant and rents were reduced to a rate so low that there was not enough revenue to meet running expenses, taxes, and interest on mortgage, the owner being left with nothing for his investment, and in many instances large overdue interest and tax accounts.

Building operations should commence next spring and a part at least of the buildings required to house our increase of population erected. Anyone owning a lot can build, as set forth above, for a cost not to exceed 5 per cent. over pre-war prices. Taxes and interest will continue to be a loss on vacant property and there is no immediate prospect for much, if any, advance in these. Banks and loan companies will be slow to take hold of anything that looks like speculative building.

It will take time, high rents, conservative building operations and methods to restore confidence. To this end the builders, manufacturers, and supply interests must work. Our statistics show the increase in population for the city of Winnipeg for the past seventeen years, is about 155,000 people; to house and care for these people $155,000,000 worth of building permits were issued, making an average of $1,000 in building permits issued for each man, woman and child, added to the population. Winnipeg increased in population during 1917 about 10,000; to keep up with this growth $10,000,000 of permits should be issued. This was not required in 1917 as we had the vacancies brought about by war conditions, but if we continue to increase at the same rate our building permits must in the very near future be at the same rate as the increase set forth above, which would mean $10,000,000 worth of permits in place of a little over two million that were issued in 1917. Should Winnipeg continue to grow at the rate of 10,000 inhabitants per year we must, to keep the same conditions as now prevail, build $10,000,000 worth of buildings. To do this we will need a great many men in each of the several building crafts, together with those required in the trades that serve their daily needs.

Yours truly,
W. P. Alsip.

Awards for Meritorious Papers

LIEUT.-Col. R. W. Leonard, of St. Catharines, Ont., has presented a gold medal, to be known as the Leonard medal, for annual competition open to the members of the Canadian Society of Civil Engineers and the Canadian Mining Institute. The medal, provided out of a special fund, is to be for papers presented to either societies. It is to be presented alternately at annual meetings of the societies, irrespective of the winner's membership therein. A committee of five will judge the papers entered for competition, all of whom are to be members of both societies; one member of the committee is to be the donor or his nominee and two each appointed by the different organizations. Should the committee not consider the papers presented in any one year of sufficient merit no award is to be made, but in the following year or years the committee will have power to award the accumulated medals or to award a second prize in the value of a silver medal, or a third prize of books. The medal is to be suitably engraved.

Approval of Montreal Permits

Recently Mr. Tremblay, chief of the Montreal fire department, requested that he be consulted before building permits are issued. Mr. A. Chausse, the city architect, objected to this on the ground that such consultation is unnecessary. The Association of Architects of the Province have communicated with the Legislation Committee on the question. They take the stand that while Mr. Tremblay should be consulted as to new buildings, the final decision should be left to Mr. Chausse as the chief building inspector.

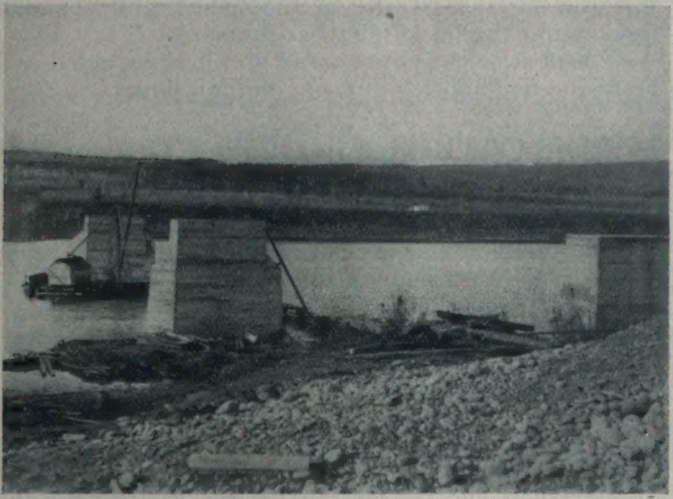
Brigadier F. O. W. Loomis, of D. G. Loomis & Sons, contractors, Montreal, who has returned from the front, was entertained by the Canadian Club of New York, on his way to Canada.

Million Dollar Steel Bridge Across the Peace River to Open Up New Country

Central Canada Railway is Constructing First Bridge Across this Waterway — Substructure Built Under Severe Ice Conditions

By W. R. Smith*

PROBABLY the most important single item of construction now being undertaken in Western Canada is the big bridge now being constructed across the Peace River, at Peace River Crossing. This will be the first bridge to span this world-famous waterway, and forms part of the extensive railroad activities of the McArthur interests in connecting up the wonderfully rich Peace River basin with the markets of the world. With the completion of this bridge, which is being built by the Central Canada Railway, under a provincial government bond guarantee, one of the richest agricultural districts on the continent, lying to the west of the Crossing and heretofore completely isolated, will at once be brought into direct contact with the railroad system of an entire continent. To the north extends three thousand miles of territory as yet undeveloped, but with practically unlimited potentialities. This vast region will now become reasonably accessible, and undoubtedly will see wonderful development in the next few years.


Piers 3, 4 and 5; No. 9 at extreme left barely visible.

So much for the economic importance of the Peace River bridge. Perhaps it may be of interest to give a few details of the structure itself, and to describe in a brief manner some unique methods which are being used, so far as the construction of the substructure is concerned.

Designed for Highway and Railway Traffic

The bridge will be of single-track type, and is designed to carry highway attachments on each side. These attachments will, however, not be placed until traffic conditions warrant them, and temporarily the deck will be floored in order to provide a roadway for vehicular traffic.

After considering various designs and having regard to all the requirements, present and future, of a navigable waterway of this importance, the following arrangement of spans was finally decided upon as giving the most economical and satisfactory form of design:

From the east abutment the spans will be arranged as follows: One 70 ft. deck plate girder; two 80 ft. deck plate girders; three 200 ft. deck truss spans; one 200 ft. through truss span; three 200 ft. deck truss spans; one 70 ft. deck plate girder.

The length between abutment parapets will be 1,737.2 feet. The through span is designed to give a clearance of 65 feet above low-water elevation and 48 feet above extreme high water, this being sufficient to meet the requirements of all Northern river navigation. The deck spans will give 19 feet clearance above high-water level.

Character of Substructure

The substructure, which was designed in the office of the chief engineer by Mr. William Jackson, late principal assistant engineer, consists as follows:

East abutment—Skeleton type, buried, and of reinforced concrete masonry, approximately 58 ft. high.

Pier No. 1—Concrete pedestal.

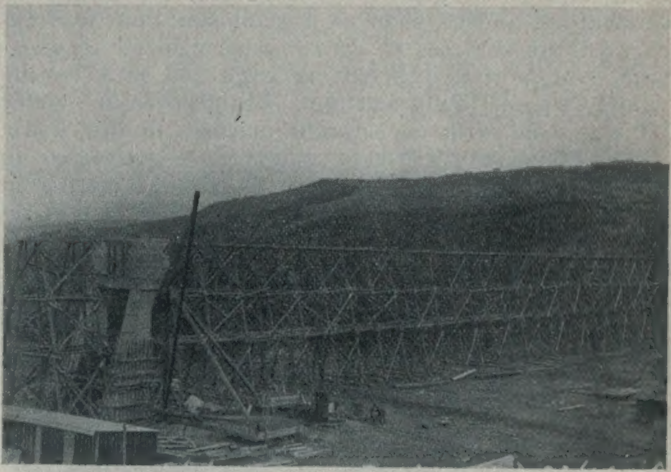
Pier No. 2—Concrete pedestal.

Pier No. 3—Concrete masonry, approximately 48 ft. high.

Pier No. 4—Concrete masonry, approximately 62 ft. high.

Pier No. 5—Concrete masonry, approximately 70 ft. high.

Pier No. 6—Concrete masonry, approximately 78 ft. high.


The east approach is a trestle which has been filled in.

Pier No. 7—Concrete masonry, approximately 82 ft. high.

Pier No. 8—Concrete masonry, approximately 86 ft. high.

Pier No. 9—Concrete masonry, approximately 70 ft. high.

Pier No. 10—Concrete pedestals.

West abutment—Skeleton type, buried, and of reinforced concrete masonry, approximately 29 ft. high.

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* General manager, and chief engineer of the Edmonton, Dunvegan & British Columbia Railway Company.

It was the original intention to commence the work early last winter, and endeavor to get in all the deep-water piers, at least, before the ice broke up, but owing to various unavoidable delays it was impossible to get the necessary equipment and material assembled at the bridge site before the first week in February. From the outset it was apparent that, owing to the depth of water at Piers 6, 7, and 8 (about 25 feet at low water), some form of caisson would have to be used, and as the element of time had now become the dominating factor, it was decided that an open concrete caisson, which would form an integral part of the structure, was the one which gave the only possible chance of accomplishment in the time available—that is, the three deep-water piers had to be in before the second week in April.

As this is probably the first time this system has been adopted in Western Canada a general description of the methods used in sinking these caissons may prove interesting.

Caisson Sinking

Guide piles were first driven through the ice at the exact location of each pier, and inside these the foundations of the caisson were started. The cutting edge consisted of a 7 in. "point" of channel iron, with sides of ⅜ in. boiler plate extending 30 in. up the sides, the outside edge being perpendicular and the inside edge battered one to one and a half. Carefully bevelled 12 in. x 12 in. timbers were then fitted into the cutting edge, and these timbers were carried solidly up to a height of 10 feet, all the timbers being strongly drifted and strapped at four feet intervals on the outside with ½ x 2½ in. wrought iron straps. At this stage the ice was cut through around the entire structure, and the caisson launched in the water. One course of 12 in. x 12 in. was then carried on up on each side of the caisson wall and the filling of the space between with concrete commenced so as to gradually sink the caisson until it came to rest on the river bottom.

Dredging was then started in each of the caisson compartments by means of orange peel and clam shell excavators, and as soon as a good size hole was excavated the services of divers were utilized to excavate from around the cutting edge and to keep the whole caisson slowly settling. A high-pressure water jet was used with considerable success in this work. An exceptionally hard bottom was encountered in Pier 8, and dynamite was used almost continuously in order to loosen the material, and this method was resorted to, though to a less extent, in Piers 6 and 7 also.

Successful Operations Under Severe Conditions

As soon as it was decided that a satisfactory foundation had been obtained, the work of filling the caissons with concrete was started, and as at this time the ice was getting in poor condition, it was decided to make no attempt to get the three piers above water, and concreting was stopped when a point about five feet below ice level was reached, in order that the ice could pass over the uncompleted piers without danger of jamming. In spite of exceptionally severe weather conditions, the work was carried on continuously day and night, and the whole operation may well be considered a success.

No attempt was made during the summer to complete these three piers, but work was started on the abutment, pedestals, and the remaining piers, and these were completed early in November. Good foundations were obtained in every case, the depth varying from 3 feet for Pier 9, consisting of a sandstone bottom, to 12 feet of hard clay in Pier. 3.

Possibly Completed by This Summer

Preparations are now being made (December 15) for the continuation of the work required to carry Piers 6, 7, and 8 to completion, and it is anticipated that the whole substructure will be completed by February 15, 1918.

Mr. S. C. Hill, a veteran Western bridge-builder, is superintendent of construction on this work, and Mr. E. A. Shuler is resident engineer.

The contract for the superstructure has been let to the Canadian Bridge Company, of Walkerville, Ont., and although some delay has been experienced in the fabrication of steel owing to the difficulty of obtaining steel from the mills, it is hoped to commence erection about January 1, 1918, with a view to having all the spans completed before the spring break-up. If this can be successfully accomplished, trains should be crossing the bridge by the summer of 1918.

The cost of the entire structure, it is expected, will be in the neighborhood of one million dollars.

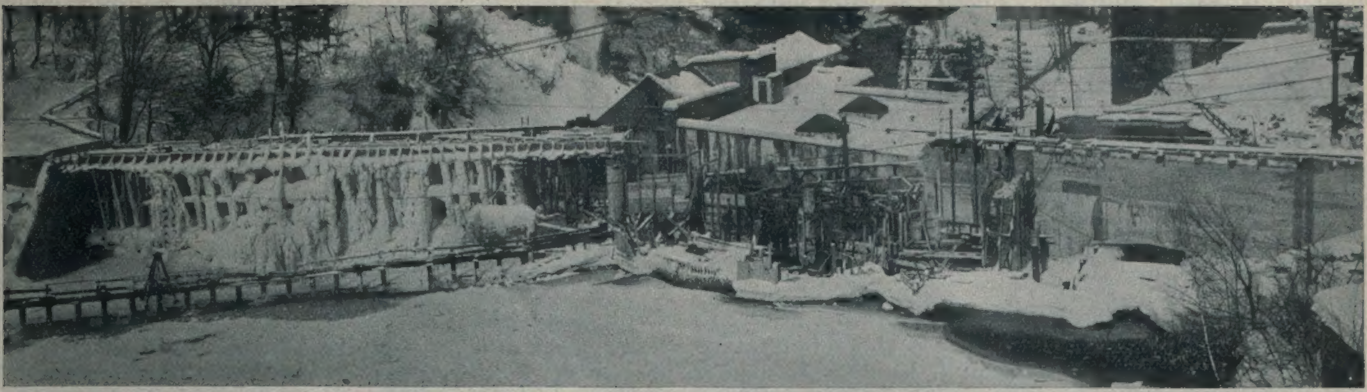
Washed Out Bridge in Quebec Temporarily Replaced in Two Days

THAT the road work in Quebec during the past season was seriously handicapped by heavy rain was pointed out in an article by B. Michaud in the Contract Record of Dec. 19. The annual report just to hand cites a particular instance where such difficulties were met with. The repair of the bridge in question within two days after its demolition is an illustration of the highway organization in Quebec.

At St. Come, on Patrick Hill, a concrete bridge of 25-foot span and 30 feet in height was demolished, with its approaches, in an instant by a heavy cloudburst, and blocks of concrete 15 to 20 feet long and from 7 to 8 feet wide and thick were carried down 150 feet abruptly, cutting an opening of over 60 feet between the two sides. Nevertheless, two days later a very solid temporary bridge was built on the site of the old road, offering the public a roadway which, if not as pleasant, was at least as safe as before. At present the bridge is completely rebuilt, timber having been substituted for concrete. This change was made for reasons of both economy and improvement. Notwithstanding the rule the department has laid down for themselves—namely, to have economy as a basis for all its operations—it would have been right in seeking to have the most durable system of reconstruction and rebuilding the bridge in concrete. The department was dissuaded from this, however, through fear that the accident might be repeated in the future, for then the total loss on a bridge such as the one which was rebuilt would be 50 per cent. less than that of a concrete bridge.

Declined to Offer Aid for Halifax

While expressing regret at the Halifax disaster, the Montreal Trades and Labor Council declined to offer aid on the ground that there was a danger of labor rates being lowered and of interference with union laws. No Montreal workmen going to Halifax should be asked to receive lower rates than those current in Montreal.



A construction view of the Sherbrooke municipal dam, looking downstream.

Pneumatic Placing of Concrete in Below-Zero Weather on Sherbrooke Dam

Capacity of Power Plant Increased by Construction of a 285 ft. Dam 56 ft. High—Steam Pipes Prevented Frozen Concrete at 10° Below Zero

By W. W. Plum*

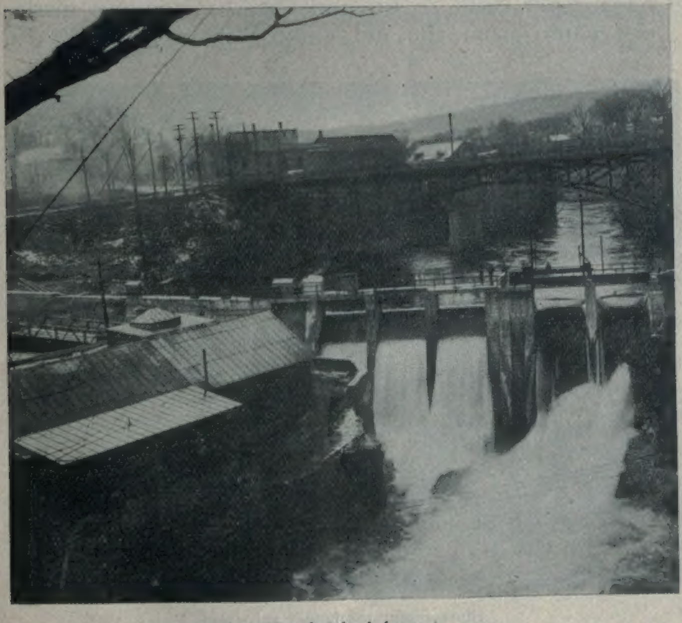
TO provide for the increased demand for electric power, the city of Sherbrooke recently built a concrete dam across the Magog River at the site of the existing power house on Frontenac Street. This dam is formed of two sections of approximately equal length, meeting at an angle of 150 degrees, pointing downstream. One section contains the headgates and the other the spillway. The total length of the dam is 285 feet; in the spillway section, the height from rock to stoplog platform is 56 feet. The concrete yardage is about 6,000, made of a 1:4 mix; the stop-log piers, curves and platforms being heavily reinforced.

The increase in head, with the new wheels and generators adds approximately 1,500 h.p. to the former capacity of this plant.

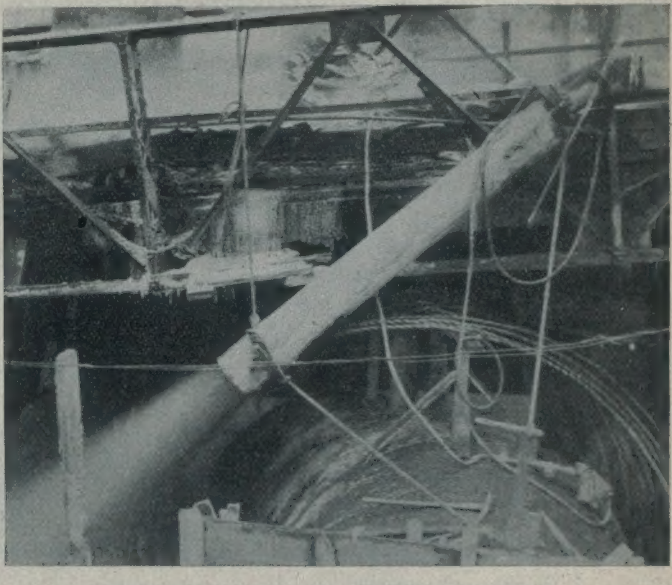
Concrete Placed Pneumatically

The concrete was poured from one point, by a pneumatic mixer, which both mixed and conveyed the concrete to the forms, by compressed air, the air being furnished by a 420 cu. ft. compressor. The mixer was installed on a slope below the street, at one end of the job. This enabled the mixer to be charged by gravity with the gravel which was unloaded directly from the street line into a bin. An 8-inch conveyor pipe was run from the mixer to any part of the job, and was a factor in eliminating trouble with the high tension transmission lines which hang over the site, and which would have made the use of a cableway very difficult and dangerous. Large stones were placed in the concrete, up to a maximum volume allowance of 35 per cent.

Concrete was poured when the temperature was as low as 10 degrees below zero, gravel and water being



The finished dam.



Concrete was mixed and poured pneumatically.

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*Of MacBean & Williams, Montreal.

heated by steam, and new concrete covered with tarpaulins and kept warm with steam until well set. A steam coil placed in the bottom of the gravel pile proved very satisfactory and in very cold weather was assisted by pipes driven into the pile from the surface. In protecting the stop-log platform, which is a 15-in. slab, with a 15-ft. span, building paper was put down on the new concrete, on which was spread 3 inches of wood shavings, and 3 inches of manure. This made sufficient covering and left a smooth surface with no discoloration.

Concreting at 30 Degrees Below Zero

During the process of this work, the temperature dropped several times to around 30 degrees below zero, but little trouble was experienced from frozen concrete. Over the sluices, which were left in the dam to take the flow of the river during construction, spray froze in heavy sheets, which required much dynamiting to dislodge.

Under the contract the city agreed to unwater the pond to facilitate the construction, but found it impracticable to do so. This necessitated the construction of cofferdams during the winter in the headgate section in order to allow continuous operation of the power plant. Divers were necessary, the maximum head of water at these cofferdams being 25 feet. About 300 linear feet of cofferdam was constructed.

The contractors on the work were MacBean & Williams, of Montreal, who executed the contract under the supervision of Mr. Thos. Tremblay, city engineer of Sherbrooke, and Mr. M. A. Sammett, consulting engineer, of Montreal. The concreting equipment was furnished by the Pneumatic Concrete Placing Company of Canada, Limited.

Fabrication and Shop Work for Quebec Bridge

Extraordinary Size of Bridge Members and Machine Tools Called for Entirely New Shops—Specially Built Machines

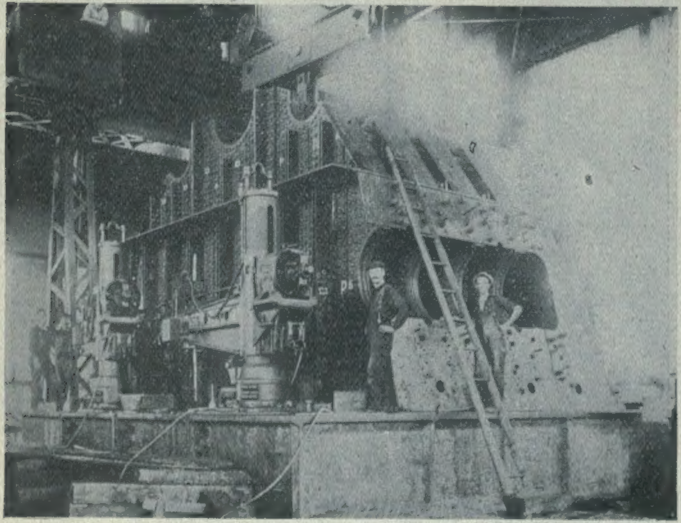
THE fabrication of the superstructure and the shop work of the Quebec Bridge were described by Mr. Phelps Johnson, president of the St. Lawrence Bridge Company, at the meeting of the Canadian Society of Civil Engineers, Montreal, on December 20. This was the third of the series of talks on the Quebec Bridge, and as on the previous occasions, the address was in the form of a commentary on a series of slides.

Mr. K. W. Blackwell, a past president, was in the chair, and prior to introducing Mr. Johnson, referred to the death of Mr. J. Hobson, who was a great engineer, and who had done splendid work, especially in railway engineering. He hoped the Council would send a message of condolence to the family.

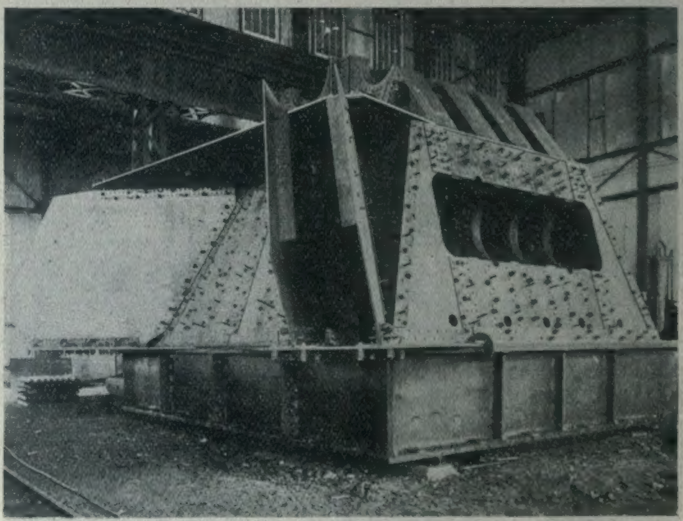
Mr. Johnson, in describing the work, commented on its great accuracy, and the immensity of the undertaking. He explained that although the Dominion Bridge Company, Lachine, and the Canadian Bridge Company, Walkerville (who combined to form the St. Lawrence Bridge Co.), had fine shops, it was decided to build an entirely new shop at Rockfield, near Montreal. This was owing to the fact that many of the members of the bridge were extremely large and heavy and called for tools of greater capacity than any in existence. The position of the Rockfield shop had decided advantages, as it enabled the material to be conveniently sent to both sides of the river. The shop was a fine specimen of workmanship and was very well equipped. In this connection Mr. Johnson paid a compliment to Mr. Ladd for the manner in which the work was fabricated and for his ingenious way of meeting problems, notably in the matter of drilling.

Mr. Johnson then described how the shops were designed, the method of dealing with material, and the various operations. One shop was 660 feet long, and was divided into two sections. The shop was equipped with two 70-ton cranes for the heavy work and two 35-ton cranes for the lighter members. The heavy members were dealt with on one side of the shop and the lighter material on the other.

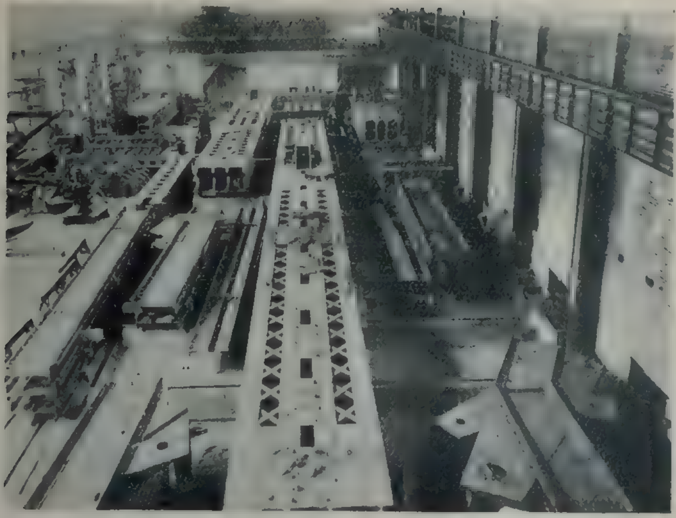
Fifty per cent. of the tools were Canadian made, some came from the old country, and others were



Reaming and assembling main shoe in shipping shed.



Shoe assembled before shipment.



Shop where heavy members were riveted, faced and bored.

Bottom chord of cantilever arm, section next to shoe, showing pin boring.

American. A series of pictures showed drills, made expressly for the work, horizontal and vertical planers, large borers, and riveters. The latter were stated to be very powerful, and were so designed as to give the full effect at the end of the stroke. There was ample stock used in the rivets. In showing pictures of the shoes, Mr. Johnson said that the steel castings were the largest made in Canada, and were of different descriptions. The large boring machine was specially built for the work. In planing, as much time was occupied in setting up the work as in doing it. The main posts weighed 1,200 tons, made up of four sections. All the heavy work was done on concrete skids carried down to rock.

Replying to questions, Mr. Johnson said that the rivets were of carbon steel.

The Chairman spoke of the microscopic accuracy of the work, and it was satisfactory to know that so many of the special tools were designed and produced in Canada.

Brig. Gen. Sir Alexander Bertram, in moving a vote of thanks to Mr. Johnson, stated that he (Sir Alexander) had had much to do with the machining work. A great deal of rock had to be quarried in order to place the machines on the proper level, and thus secure absolute accuracy in the boring work.

Senator J. P. B. Casgrain seconded the vote, and gave details of the inside history connected with the decision to abandon the proposed two 23-ft. roadway drives proposed in the original plans. He had a considerable influence in this decision, which saved four and one-half million dollars.

Dominion Bridge Company's Profits For Past Year

For the year ending October 31st, the profits of the Dominion Bridge Company totalled $1,186,436, a decline of $1,575,844, due, it is stated, to unremunerative contracts for shells and other munition work. Referring to the successful completion of the Quebec Bridge, Mr. Phelps Johnson, the president, states that the company will receive about $1,500,000 as its share of the profits accumulated in the seven years the work has been in progress and also benefit by the return of a good portion of the cash capital investment in the work. The company has secured contracts for marine boilers and engines totalling about $1,700,000, at prices which it is believed will prove satisfactory. The company has also secured contracts for fabricating ships' plates and frames which will keep the structural departments in Lachine and Toronto busy for seven months.

Middle section of main shoe loaded for shipment.

Main shoe showing connections made to cantilever arm side.

Roads the Keynote to Military Success

A Condensed Address by W. D. Sohier Before American Association of State Highway Officials Describes Road Work in the War Zone

THE subject of military roads is one of the utmost importance to the world at the present time; in fact, the results of the war really are going to depend fully as much upon roads and highways as they are upon any other one factor, because it is manifest that if you cannot feed your men, move your guns, supply them with artillery and ammunition, you cannot maintain an army in an existing location.

While the railroads and steamships are vitally necessary to bring the supplies and men, ammunition to the artillery, and everything needed for modern war, to the country, and from the large storehouses to the railheads, the soldiers in the trenches, and more particularly the soldiers back of the trenches that are holding the long battle lines, have to be almost entirely supplied over the roads.

Roads the Keynote to Military Success

The whole battle of Verdun was really fought, as far as the French were concerned, with soldiers, ammunition, guns, and supplies that were transported over the roads, because one railroad which originally supplied that region was cut by the Germans, and the other one was dominated by their artillery. The consequence was that the army was supplied with ammunition, guns and men that came over the roads.

From one point of view, all roads which are of any importance are military; to wit, any roads which have to be used for the transportation of any of the products which are necessary for the conduct of the war or the feeding of the people with the articles that are necessary to sustain life. It is a question of relative importance, but under existing conditions we should certainly confine our efforts to those roads which are of the most importance from this point of view.

Virtually all of the roads in France were military roads. The French road system was admirably adapted to be used for military purposes. This can be illustrated by a few figures:

France had, when the war started, over 371,000 miles of macadam road. These roads had been built for many years; they were all graded, with foundations where necessary, and all had adequate drainage. Virtually all had a hardened surface of waterbound macadam, though a certain percentage had been built with a bituminous surface.

There were about 32,000 miles of national or departmental highways, or about 10 per cent. of the whole. These main arteries connected all the more important cities and villages with a network of main highways through the whole of France.

The width of the "Route Nationale," including ditches, was 60 feet; the macadam surface was usually 24 ft. wide, with about 15 ft. of graded road on each side and then a ditch. The "Route Departmentale" was about 42 ft. in width, with a macadam surface usually about 18 ft. wide.

Secondary Roads

There were also over 107,000 miles of road of secondary importance, what might be called county roads, connecting all the little towns, villages and hamlets. There were 47,500 miles of road that were perhaps of interest to two or more towns. These roads were graded about 30 ft. in width, including ditches. Then there were about 184,000 miles of what might be called ordinary country roads.

The roads of the least importance had a macadam surface about 9 ft. in width, but were graded 27 ft. in width.

So far as I can learn, it was this road system which enabled the armies of France to stem the German armies' rush on Paris, and to throw them back to where the trenches were first made.

France has been so well supplied with roads in most of the sections on the battle line that it has been unnecessary to build very many more, except in particular places. The big problem has been to keep up and maintain what they had, with the tremendous traffic that had to go continuously over them.

In a few instances, when the battle line became established certain roads and cross roads were so located, for instance, near Verdun, that they were easily visible and subject to shell fire. Therefore, a few miles of road have been relocated on the lee side of the hills where they were out of sight of the German batteries and relatively safe from shell fire.

Maintenance Under Tremendous Traffic

The traffic has been so tremendous that naturally the roads have been very rapidly worn out, and as they had to be kept in continuous use, certainly whenever that particular section of the battle line was active, it was impossible to do more than throw material onto the road and allow the traffic to roll it down.

When divisions have to be moved the utmost capacity of the main roads is required for the trucks, artillery, etc., and the slow-moving trucks and the light motor ambulances and other motor vehicles have to take longer routes on the roads of less importance, so that these country roads have been absolutely necessary during the war.

The slow-moving horse-drawn vehicles are required to hug the shoulders of the road, the fleets of motor trucks pounding steadily by in the middle, spaced about 50 ft. apart, travelling at from 12 to 15 miles an hour.

During the attack at Verdun, the Bar-le-Duc-Verdun road, about 50 miles in length, had to carry a continuous procession of about 5,000 motor trucks every 24 hours.

The roads were kept constantly in repair by putting on broken stone wherever it could be obtained, though, of course, when any serious large break in the road occurred it had to be filled with any material available, quite often stone from the foundations of buildings, brick and other material.

Whenever there was a lull and it was possible to put the roads into better condition, it has usually been done by scarifying by hand and building half the road surface, possibly 1 or 2 inches in depth, of broken stone, in some localities obtained by rail but usually from some local stone supply, or the stone taken from the villages where the buildings had been destroyed. The stone has been broken up by hand, either at the source of supply or on the side of the road, and when it was possible steam rollers have been used to consolidate it.

When the actual fighting is going on it has had to be shoveled in from the roadside and allowed to compact under traffic, which it does very rapidly in wet weather. Occasionally clay or dirt has been used to help it hold.

Army Roads in Charge of Experienced Engineer

The experienced road builder of executive ability has found his place in this war. The roads back of the English army are being built and cared for under the direction of Brig.-Gen. H. P. Maybury, who was one of the English county engineers and was afterward one of the engineers on the Road Board in England; and he has under him, in charge of the road work, experienced men. One of these men, formerly with one of our large companies, is now a lieutenant-colonel. Back of one of the British armies this engineer has had charge of the roads for two years, and has had from 10,000 to 12,000 men working on them constantly. Twenty-five or thirty per cent. of these have been German prisoners.

In order to keep the roads merely passable they have had to use up to 2,000 tons of metal a day. Broken stone costs $7.50 a ton. It isn't a question of cost, however; it is a question of keeping the traffic going.

Chicago's Revised Flat Slab Ruling

Original Chicago Code, an Accepted Standard, Has Been Amended in the Light of Three Years' Experience with This Type of Building

BECOMING effective on January 1, 1918, a revised ruling on the design of reinforced concrete flat-slab construction has been issued by Charles Bostrom, commissioner of buildings, Chicago. The original "Chicago Ruling," which was put into effect three years ago, has been widely accepted as a standard method of computing for the flat-slab system and recognized as perhaps the leading code on this type of construction. As buildings of the girderless type have gained in favor, experience has shown the need for some modifications, mainly in form or in enlargement of scope. The amended ruling, therefore, has been produced to include the most up-to-date information on the subject. Owing to the interest the Chicago ruling has for all designers of flat-slab buildings, we reproduce it in full herewith:

Definitions

1. Flat slabs as understood by this ruling are reinforced concrete slabs, supported directly on reinforced columns with or without plates or capitals at the top, the whole construction being hingeless and monolithic without any visible beams or girders. The construction may be such as to admit the use of hollow panels in the ceiling or smooth ceiling with depressed panels in the floor.

2. The column capital shall be defined as the gradual flaring out of the top of the column without any marked offset.

3. The drop panel shall be defined as a square or rectangular depression around the column capital extending below the slab adjacent to it.

4. The panel length shall be defined as the distance c. to c. of columns of the side of a square panel, or the average distance c. to c. of columns of the long and short sides of a rectangular panel.

Columns

5. The least dimension of any concrete column shall be not less than one-twelfth the panel length, nor one-twelfth the clear height of the column.

Slab Thickness

6. The minimum total thickness of the slab in inches shall be determined by the formula: $t = \sqrt{W}/44$ (= square root of W divided by 44), where t = total thickness of slab in inches, W = total live load and dead load in pounds on the panel, measured c. to c. of columns.

7. In no case shall the thickness be less than 1/32 of the panel length (L/32) for floors, nor 1/40 of the panel length (L/40) for roofs (L being the distance c. to c. of columns).

8. In no case shall the thickness of slab be less than 6 in. for floors or roofs.

Column Capital

9. When used the diameter of the column capital shall be measured where its vertical thickness is at least 1½ in., and shall be at least 0.225 of the panel length.

The slope of the column capital shall nowhere make an angle with the vertical of more than 45 degrees. Special attention shall be given to the design of the column capital in considering eccentric loads and the effect of wind upon the structure.

Drop Panel

10. When used, the drop panel shall be square or circular for square panels and rectangular or elliptical for oblong panels.

11. The length of the drop shall not be less than one-third of the panel length (L/3) if square, and not less than one-third of the long or short side of the panel respectively if rectangular.

12. The depth of the drop panel shall be determined by computing it as a beam, using the negative moment over the column capital specified elsewhere in this ruling.

13. In no case, however, shall the dimensions of the drop panel be less than required for punching shear along its perimeter, using the allowable unit shearing stresses specified below.

Shearing Stresses

14. The allowable unit punching shear on the perimeter of the column capital shall be 3/50 of the ultimate compressive strength of the concrete as given in section 533 of the building ordinance. The allowable unit shear on the perimeter of the drop panel shall be 0.03 of the ultimate compressive strength of the concrete. In computing shearing stress for the purpose

of determining the resistance to diagonal tension the method specified by the ordinance shall be used.

Panel Strips

15. For the purpose of establishing the bending moments and the resisting moments of a square panel the panel shall be divided into strips, known as strip A and strip B. Strip A shall include the reinforcement and slab in a width extending from the centre line of the columns for a distance each side of this centre line equal to one-quarter of the panel length. Strip B shall include the reinforcement and slab in the half width remaining in the centre of the panel. At right angles to these strips the panel shall be divided into similar strips A and B, having the same widths and relations to the centre line of the columns as the above strips. These strips shall be for designing purposes only, and are not intended as the boundary lines of any bands of steel used.

16. These strips shall apply to the system of reinforcement in which the reinforcing bars are placed parallel and at right angles to the centre line of the columns, hereinafter known as the two-way system, and also to the system of reinforcement in which the reinforcing bars are placed parallel, at right angles to and diagonal to the centre line of the columns hereinafter known as the four-way system.

17. Any other system of reinforcement in which the reinforcing bars are placed in circular, concentric rings and radial bars, or systems with steel rods arranged in any manner whatsoever, shall comply with the requirements of either the two-way or the four-way system herein specified.

Bending Moment Coefficients, Interior Panel, Two-way System

18. In panels where standard drops and column capitals are used as above specified, the negative bending moment, taken at a cross section of each strip A at the end of the column capital or over it, shall be taken as WL/30.

19. The positive bending moment taken at a cross-section of each strip A midway between column centres shall be taken as WL/60.

20. The positive bending moment taken at a cross-section of each strip B in the middle of the panel shall be taken as WL/120.

21. The negative bending moment taken at a cross-section of each strip B on the centre line of the columns shall be taken as WL/120.

22. In the formulas hereinabove given W = total live and dead load on the whole panel in pounds, L = panel length, c. to c. of columns.

Bending Moment Coefficients, Interior Panel, Four-way System

23. In panels where standard drops and column capitals are used as above specified, the negative bending moment, taken at a cross-section of each strip A at the edge of column capital or over it, shall be taken as WL/30.

24. The positive bending moment taken at a cross-section of each strip A, midway between column centres, shall be taken as WL/80.

25. The positive bending moment, taken at a cross-section of each strip B, taken in the middle of the panel, shall be taken as WL/120.

26. The negative bending moment, taken at a cross-section of each strip B on the centre line of the columns, shall be taken as WL/120.

Bending Moment Coefficients, Wall Panels

27. Where wall panels with standard drops and capitals are carried by columns and girders built in walls, as in skeleton construction, the same coefficients shall be used as for an interior panel, except as follows: The positive bending moments on strips A and B midway between wall and first line of columns shall be increased 25 per cent.

28. Where wall panels are carried on new brick walls these shall be laid in portland cement mortar, and shall be stiffened with pilasters as follows: If a 16 in. wall is used, it shall have a 4 in. pilaster; if a 12 in. wall is used, it shall have an 8 in. pilaster. The length of pilasters shall be not less than the diameter of the column, nor less than one-eighth of the distance between pilasters. The pilasters shall be located opposite the columns as nearly as practicable, and shall be corbeled out 4 in. at the top, starting at the level of the base of the column capital. Not less than 8 in. bearing shall be provided for the slab, the full length of wall.

The coefficients of bending moments required for these panels shall be the same as those for the interior panels except as provided herewith: The positive bending moments on strips A and B midway between the wall and first line of columns shall be increased 50 per cent.

29. Where wall panels are supported on old brick walls there shall be columns with standard drops and capitals built against the wall, which shall be tied to the same in an approved manner, and at least an 8 in. bearing provided for the slab, the full length. Where this is impracticable there shall be built a beam on the underside of slab, adjacent to the wall between columns, strong enough to carry 25 per cent. of the panel load.

The coefficients of bending moments for the two cases of slab support herein described shall be the same as those specified in Section 27 and Section 28 for skeleton and wall bearing condition respectively.

30. Nothing specified above shall be construed as applying to a case of slabs merely resting on walls or ledges, without any condition of restraint. These shall be figured as in ordinary beam-and-girder construction specified in the ordinances.

Bending Moment Coefficients, Wall and Interior Columns

31. Wall columns in skeleton construction shall be designed to resist a bending moment of WL/60 at floors and WL/30 at roof. The amount of steel required for this moment shall be independent of that required to carry the direct load. It shall be placed as near the surfaces of the column as practicable on the tension sides, and the rods shall be continuous in crossing from one side to another. The length of rods below the base of the capital and above the floor line shall be sufficient to develop their strength through bond, but not less than 40 diameters, nor less than one-third the clear height between the floor line and the base of the column capital.

32. The interior columns must be analyzed for the worst condition of unbalanced loading. It is the intention of this ruling to cover ordinary cases of eccentric loads on the columns by the requirement of Section 5. Where the minimum size of column therein specified is found insufficient, however, the effect of the resulting bending moment shall be properly divided between the adjoining slab and the columns above and below according to best principles of engineering, and

the columns enlarged sufficiently to carry the load safely.

Bending Moment Coefficients, Panels Without Drops, or Capitals, or Both

33. In square panels where no column capital or no depressions are used the sum total of positive and negative bending moments shall be equal to that computed by the following formula:

$$B.M. = (WL/8)\ (1.53 - 4k + 4.18k^3)$$

where

B.M. = Numerical sum of positive and negative bending moments, regardless of algebraic signs.

W = Total live and dead load on the whole panel;

L = Length of side of a square panel, c. to c. of columns;

k = Ratio of the radius of the column or column capital to panel length, L.

This total bending moment shall be divided between the positive and the negative moments in the same proportion as in the typical square panels for two-way or four-way systems specified above for interior and wall panels respectively.

Point of Inflection

34. For the purpose of making the calculations of the bending moment at the sections away from the column capital, the point of inflection shall be considered as being one-quarter the distance c. to c. of columns, both crosswise and diagonally, from the centre of the column.

Tensile Stress in Steel and Compressive Stress in Concrete

35. The tensile stress in steel and the compressive stress in the concrete to resist the bending moment shall be calculated on the basis of the reinforcement and slab in the width included in a given strip, and according to the assumptions and requirements given in Sections 532-535, inclusive, of the building ordinance. The steel shall be considered as being concentrated at the centre of gravity of all the bands of steel in a given strip.

36. For the four-way system of reinforcement the amount of steel to resist the negative bending moment over the support in each strip A shall be taken as the sum of the areas of steel in one cross-band and one diagonal band. The amount of steel to resist the positive bending moment of each strip B shall be considered as the area of the steel in a diagonal band. The amount of steel to resist the positive bending moment in each strip A shall be considered as the area of the steel in a cross band, and the amount of steel to resist the negative moment in each strip B shall be the steel included in the width of strip B.

37. For the two-way system of reinforcement the amount of steel to resist the bending moment in any strip shall be considered as the area of steel included in the width of the strip.

38. In both systems of reinforcement the compressive stress in the concrete in any strip shall be calculated by taking the area of steel considered for each strip and applying it in a beam formula based on the principles of Section 535 of the building ordinance.

39. Where drop panels are used, the width of beam assumed to resist the compressive stresses over the column capital shall be the width of the drop.

40. The width of beam, where no drop panels are used, shall be the width of steel bands. Where this is found insufficient, the area shall be increased by introducing compression steel in the bottom of slab.

Rectangular Panels

41. When the length of panel in either two-way or four-way system does not exceed the breadth by more than 5 per cent., all computations shall be based on a square panel whose side equals the mean of the length and breadth, and the steel equally distributed among the strips according to the coefficients above specified.

42. In no rectangular panel shall the length exceed the breadth by more than one-third of the latter.

Rectangular Panels, Four-way System

43. In the four-way system of reinforcement, where length exceeds breadth by more than 5 per cent., the amount of steel required in strip A, long direction, both positive and negative, shall be the same as that required for the same strip in a square panel whose length is equal to the long side of the rectangular panel.

44. The amount of steel, strip A, short direction, positive and negative, shall be the same as that required for the same strip in a square panel, whose length is equal to the short side of the rectangular panel.

45. The amount of steel in strip B, positive and negative, shall be the same as that required for similar strip in a square panel whose length is equal to the mean of the long and the short side of the rectangular panel.

46. In no case shall the amount of steel in the short side be less than two-thirds of that required for the long side.

Rectangular Panels, Two-way System

47. In the two-way system of reinforcement the amount of steel required for the positive and the negative moment of each strip A shall be determined in the same manner as indicated for the four-way system above.

48. The amount of steel in strip B, positive and negative, running in short direction, shall be equal to that required for the same strip in a square panel whose length equals the long side of the rectangular panel.

49. The amount of steel in strip B, long direction, positive and negative, shall be equal to that required for the same strip in a square panel, whose length equals the short side of the rectangular panel.

50. In no case shall the amount of steel in strip B, long direction, be less than two-thirds of that in the short direction.

Walls and Openings

51. Girders and beams shall be constructed under walls, around openings, and to carry concentrated loads.

Spandrel Beams

52. The spandrel beams or girders shall, in addition to their own weight and the weight of the spandrel wall, be assumed to carry 20 per cent. of the wall panel load uniformly distributed upon them.

Placing of Steel

53. In order that the slab bars shall be maintained in the position shown in the design during the work of pouring the slab, spacers and supports shall be provided satisfactory to the commissioner of buildings. All bars shall be secured in place at intersections by wire or other metal fastenings. In no case shall the spacing of the bars exceed 9 in. The steel to resist the

negative moment in each strip B shall extend one-quarter of the panel length beyond the centre line of the columns in both directions.

54. Splices in bars may be made wherever convenient, but preferably at points of minimum stress. The length of splice beyond the centre point, in each direction, shall not be less than 40 diameters of the bars nor less than 2 ft. The splicing of adjacent bars shall be avoided as far as possible.

55. Slab bars which are lapped over the column, the sectional area of both being included in the calculations for negative moment, shall extend not less than 0.25 of the panel length for cross bands and 0.35 of the panel length for diagonal bands, beyond the column centre.

Computations

56. Complete computations of interior and wall panels and such other portions of the building as may be required by the commissioner of buildings shall be left in the office of the commissioner of buildings when plans are presented for approval.

Test of Workmanship

57. The commissioner of buildings or his representative may choose any two adjacent panels in the building for the purpose of ascertaining the character of workmanship. The test shall not be made sooner than the time required for the cement to set thoroughly, nor less than six weeks after the concrete has been poured.

58. All deflections under test load shall be taken at the centre of the slab, and shall be measured from the normal unloaded position of the slab. The two panels selected shall be uniformly loaded over their entire area with a load equal to the dead load plus twice the live load, thus obtaining twice the total design load. The load shall remain in place not less than 24 hours. If the total deflection in the centre of the panel under the test load does not exceed 1/800 of the panel length the slab may be placarded to carry the full design live load. If it exceeds this amount of deflction, and recovers not less than 80 per cent. of the total deflection within seven days after the load is removed, the slab may be placarded to carry the full design live load. If the deflection exceeds the allowable amount above specified, and the recovery is less than 80 per cent. in seven days after the removal of the test load, other tests shall be made on the same or other panels, the results of which will determine the amount of live load the slabs will be permitted to carry.

General

59. The design and execution of the work shall conform to the general provisions and the spirit of the Chicago Building Ordinances in points not covered by this ruling and to the best engineering practice in general.

Enforcement

60. This ruling shall go into effect on and after January 1, 1918. All previous rulings on flat slabs are hereby rescinded.

Tests to Determine Loss of Heat By Radiation

QUITE a unique test for determining loss of heat by radiation from boiler settings and steam drums has been run by Mr. C. A. Eastwood, Superintendent of Station A, Pacific Gas and Electric Company, San Francisco, Cal. For his experiment Mr. Eastwood selected a 560 h.p. B & W boiler, the steam drums of which were covered with one course of common brick. A rectangular can containing a measured quantity of water was placed on top of one drum and the boiler was run at its rated capacity for a period of three days. During this time the rise in temperature of the water was carefully noted, and with these data it was a comparatively simple matter to determine (a) the amount of heat radiated per square foot of surface per hour; (b) the amount of heat radiated from the total exposed area of the drums; and (c) the quantity of fuel which was being burned to make up for this loss. Mr. Eastwood's figures showed that the loss totalled 390 barrels of oil per year.

63 Per Cent. Saving with Insulating Brick

To determine how much of this fuel-loss could be saved by the use of an effective heat insulating material, one 2½-inch course of Nonpareil Insulating Brick, manufactured by the Armstrong Cork & Insulation Company, Pittsburgh, Pa., was then placed on top of the common brick covering, and readings were taken as in the preceding tests. The result showed that with the insulating brick in place the loss of heat amounted to only 144 barrels of oil per year—a saving of 246 barrels, or 63 per cent. With oil costing only 70 cents per barrel, the saving amounted to $172.20 per year—more than enough to pay for the cost of the insulating brick and the labor required for installing them.

In considering these figures, there are two points in connection with them that should not be overlooked: First, the total amount of heat loss represents that radiated from the steam drums alone; second, only 2½ inches of insulating brick were used. Had the radiation from the exposed boiler walls been included as well, the total heat-loss would have been greatly increased. Furthermore, if the common brick had been removed entirely and replaced with a course of insulating brick set on edge, giving 4½ inches of insulation instead of 2½ inches, a still greater saving would have been effected, since these brick, the manufacturers state, are ten times better heat insulators than either common brick or fire brick.

Mr. Hawken, Ontario Representative Dominion Paint Works

To cope with the increase of their business, the Dominion Paint Works, Limited, have appointed Mr. Arthur J. S. Hawken as Ontario representative. Mr. Hawken is a native of Toronto, the son of the late James Hawken, of the Manning Estate. His old friends will remember him as an active member of the Toronto Canoe Club and of the Queen's Own Rifles.

Mr. Hawken has latterly been located in Montreal, where he joined the Victoria Rifles and for the last six months has been acting adjutant of the battalion under Lieut.-Col. B. G. Winans. He will now have his headquarters in Toronto at the offices of the company in the Lumsden Building, along with Mr. E. L. Warner, the sales manager for the company.

Officers of Calgary Branch C. S. C. E.

At the annual meeting of the Calgary Branch of the Canadian Society of Civil Engineers, held on December 1, officers for the ensuing year were elected as follows: Chairman, William Pearce; secretary-treasurer, C. M. Arnold; executive committee, S. G. Porter, A. S. Chapman and H. Sidenius.

Methods Employed in the Construction of a Siphon Tunnel

THE siphon tunnel discussed in this article is one of three large, concrete, double-deck siphons included in the construction of the new intercepting sewer system being built for the city of Milwaukee, Wis. In addition to the construction of the actual intercepting sewers, a complete disposal plant is also to be built, the entire project being carried on under the engineering supervision and direction of the Sewerage Commission of the city of Milwaukee. All work on this tunnel is being done by the John F. Casey Engineering and Construction Company of Pittsburgh as part of a contract awarded them in April, 1916. The following discussion is limited to a general description of the siphon tunnel and a review of the constructional methods used in driving and concreting, but contains practically no data on design.

General

The intercepting sewer system is of the dual type. For purposes of general design the city was divided into four watersheds, each drained by one of the four watercourses in Milwaukee. Since each of these areas included lands too low to permit sewage to be delivered to the site selected for the disposal plant and also areas that would permit a gravity flow to the plant, the high and low level intercepting system was decided upon. At the point where the sewage is delivered to this siphon tunnel the high-level sewer has a diameter of 72 inches, and the low-level sewer is 48 inches in diameter.

The sewage is delivered to the siphon at a drop shaft located at the corner of Fowler and West Streets, at a point 128 feet west of the west bank of the Milwaukee River and is carried to a riser shaft situated at the corner of Detroit and Broadway Streets, a distance of 604 feet from the east bank of the river and a total distance of 1,015 feet from the drop shaft.

Compressed air was delivered to the tunnel immediately after the drop shaft was sunk and was used continuously thereafter. A maximum pressure of 21 lbs. per square inch was required during the early stages of the work, particularly when the eye of the tunnel was being cut, while an average pressure of 14 lbs. was sufficient for the remainder of the work.

The power house constructed on the job contains three complete motor-driven compressor units, a steam boiler for the steam pumps, and a hydraulic pressure machine. The Watson Stillman hydraulic machine was driven by a 30 h.p. motor, its accumulator carried weights from 10 to 15 tons and was capable of furnishing a pressure up to 5,000 lbs. per square inch.

The Shafts

The site at West Water and Fowler Streets being definitely chosen for the sinking of the drop shaft, work was commenced by the contractor on June 27, 1916. The shaft is rectangular in shape, has bottom dimensions of 23 ft. x 23 ft. and is 16 ft. square on the bottom. It is excavated to a depth sufficient to give the top of the tunnel an elevation of minus 39. The material encountered at first was sand and stiff clay, but the character of the ground encountered at lower depths and determinations made by several borings under the Milwaukee River indicated that below minus 39 it was probable that sand and gravel would constantly occur. To avoid tunneling in this material permission was granted the contractor to change the elevation of the top of the tunnel from minus 50 to minus 39.

The shaft was driven by means of Lackawanna steel sheathing. After the first set of 28-ft. x 14-in. sheathing was placed, excavation was carried on to a depth of — 18.00, the second set of 50-ft. x 14-in. sheathing was then arranged to form a complete box 16 ft. square, and each piece was driven separately and in place, insuring a tight, compact job. When excavation had progressed to within several feet of grade, grout pipes were driven in and a mushroom bottom grouted at the end of the sheathing, after which excavation was continued to grade and a 6-in. concrete slab poured. A cradle for the hydraulic shield was now constructed on the bottom of the shaft and the shield erected into place. A timber deck was then set several feet above the top of the shield, and the upper part of the shaft was immediately concreted in, all the steel sheathing being left in place. Air locks were now set in, compressed air was supplied and the eye for the tunnel was cut through the steel.

The inside dimensions of the riser shaft, which will include a valve chamber, is 16-ft. 3-in. x 17-ft. 9-in. and was driven by the use of three sets of timber sheathing. The outside set was made up of 4-in. x 10-in. timbers driven to a depth of 9 ft. This was followed by a box of 4-in. x 8-in. timbers driven 20 ft., and the inside timbers were 4-in. x 8-in. and 20 ft. long. After a 10-in. slab was placed on the bottom of the shaft, forms for the riser section of the 36-in. sewer were put in and concrete was poured to a depth of 6 ft. No more work was done on this shaft until the shield emerged through the sheathing, after which the wooden forms for the arch transition section were set. This transition section converts the arch section (or high-level sewer) into two 60-inch circular risers, one of which will connect through a "Y" special into the 60-inch high-level sewer on Broadway Street. The other 60-inch riser of the transition section will be temporarily capped and made available for future connections. The 36-inch riser makes connections with the low-level concrete 68-in. x 49-in. sewer on Broadway.

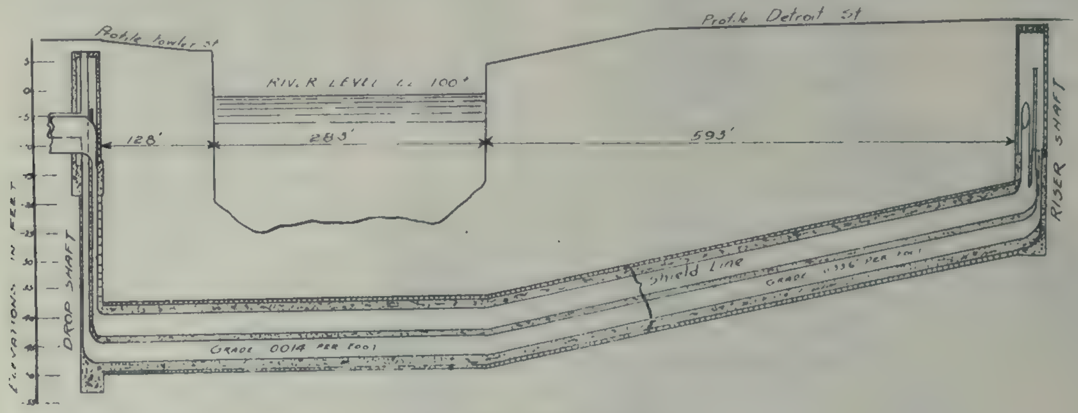
During all driving operations a 2-inch Nye pump was able to handle all seepage in the riser shaft, while a 3-inch Nye pump was required for the drop shaft.

Driving the Tunnel

The 1,015-ft. tunnel which connects the drop and riser shafts was driven circular in shape, with an outside diameter of 13 ft. The floor of the tunnel at the drop shaft heading is 49.09 ft. below water level, whence it slopes up at a grade of .14 per cent. to a point beneath the east shore of the Milwaukee River, where the grade is changed to 3.2 per cent., and continues at this grade to the bottom of the riser shaft, the elevation here being 28.65 ft. below the river water level.

The tunnel was excavated by means of a hydraulic shield, which was 9 ft. 6 in. long and built of steel. Motive power was applied to it through 14 hydraulic jacks, each designed to carry a working pressure of 6,000 lbs. per square inch, and having an extension of 22 in. Hydraulic pressure varying from 2,800 to 5,000 was sufficient to push the shield at all points in the tunnel. After 100 ft. of tunnel had been driven a steel airlock of two chambers was constructed and securely concreted into place.

As the shield was pushed along 6-in. x 8-in. hardwood and 4-in. x 8-in. yellow pine cants were placed, the hydraulic jacks being pushed directly against them. This resulted in a very tight job of the timbering. The muck was shoveled into ½-yard collapsible cars, which were pushed out through the material lock, led onto a hoist, lifted up and dumped into a hopper on top of the shaft and then delivered into auto trucks. The shield carried a platform placed on springline and a timber platform at the same elevation was built in the tunnel in successive sections as the shield was pushed along. Upon this platform the tracks were laid, which greatly facilitated the removal of muck by allowing the cars to be led directly into the shield. The shield was also divided into quadrants, two openings being below the platform and two above. The two miners in the lower part of the shield threw their muck onto a small timber platform, which was set within one foot of the bottom of the tunnel and carried along close to the shield; here it was relayed by two muckers to the springline platform and then thrown into the cars. The miners in the upper part of the shield dumped the muck directly into the cars, or threw it onto the tunnel platform, from which it was thrown into the cars.



Profile of siphon tunnel.

Checked After Each Push

After each push a check was made upon the shield by the engineer and data of the following nature were furnished the shield operator: (1) Position of shield with respect to center line of tunnel; (2) horizontal lead; (3) vertical lead; and (4), grade. With this information, the shield operator could constantly adjust the position of the shield.

After the tunneling had progressed to a point some 900 feet from the drop shaft and the concrete had been carried up to station 8+91, a steel bulkhead was placed in both the arch and circular sections, a door being left in the arch so as not to interfere with the operation of the muck cars during mining. A timbered box tunnel (a monkey drift) was now started from the riser shaft and carried in towards the shield. Meanwhile driving with the shields from the inside was continued, and when only 18 ft. of the marsh clay was left between the heading of the monkey drift and the cutting edge of the shield a material loss of compressed air occurred. The bulkhead door was now closed, the monkey drift was driven into the shield and the shield was driven straight ahead, completely "biting off" the smaller tunnel. When the shield finally reached the riser shaft the jacks were removed, the platform and pockets cut away, and the shell was allowed to remain in the ground.

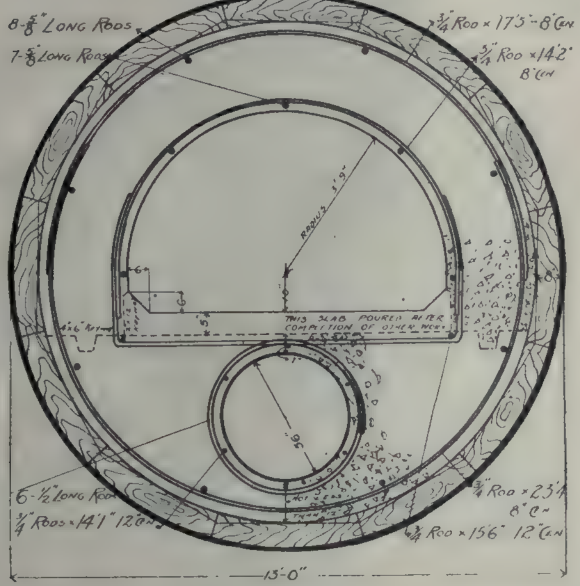
The character of the material encountered varied, although the greater portion of the last 600 feet was marsh clay. For a considerable distance underneath the river large quantities of running sand and gravel were continually met with. This necessitated a constant breasting of the face at the cutting edge of the shield, but when the end of the river was reached and a change of grade occurred the shield gradually rose out of the sand into a uniform bed of marsh clay. Practically all work on the siphon tunnel was carried on 24 hours per day, employing three shifts of 17 men each. One day's mining and timbering averaged from 10 to 15 ft.

Concreting

The concrete work on the siphon tunnel was done in three distinct stages; first, the bottom was placed, entirely enclosing the 36-inch sewer, the top of the pour being 7 inches from the top of the circular forms; the arch was then concreted in, and finally a 5-inch slab was laid along the bottom of the arch section, making the total distance from the top of the 36-inch sewer to the flow line of the upper sewer 12 inches.

In placing the lower sewer, circular steel forms built in 4-ft. lengths were used. The sections for putting in the concrete were set in various lengths, usually 47 ft., and after the proper reinforcing steel was set the section was closed off by means of temporary timber bulkheads, on which were placed 4-in. x 6-in. keys. Since the platform built during the mining operations was entirely clear of this bottom pour, the ½-yard cars of concrete could be brought in upon it to the place immediately above the section to be concreted and the concrete dumped directly into place. This permitted a minimum of shoveling, and by keeping two spaders continually below the platform a well-tamped concrete job was secured. A 4-inch galvanized iron pipe was carried along between the timbering and the forms, which succeeded in draining off the water.

In concreting the arch, hydraulic pressed steel forms were used. Each set of forms making an arch section of the correct dimensions, consisted of eight plates and one pair of pressed steel ribs. The plates were made in 4-ft. lengths of varying widths and had steel facings with laminated wooden backs. The forms were set up in 16-ft. sections, most of the steel reinforcing being set before the form ribs were put up, and the sections were closed off with timber bulkheads similar to those used in the bottom. By putting up the wall plates in single rows the concrete could be conveniently placed, tamped and inspected. Except for the two top key plates, each row of plates was clamped in as soon as the concrete had reached the top of the preceding row, but in "keying up" each 4-ft. section was entirely completed before the next pair of key plates were put up. Two-inch grout pipes were placed through the concrete in the top of the arch every 16 ft., grout being pumped through them after all the rest of the concreting was completed.



Cross section of siphon tunnel.

After the bottom sewer and arch were concreted the 5-inch slab was placed. The surface on which the slab was to be laid was thoroughly cleaned and chipped and a rich mixture of concrete was placed through the entire length of the tunnel. The surface of the slab was carefully screeded and finished.

Except for the small section of tunnel adjoining the airlock, no concreting was done until the wing had progressed half way across the river, a distance of some 200 feet. Concreting of the bottom was then commenced and followed along about 100 feet behind the shield. After the mining had progressed entirely across the river and the bottom section had been placed up to the same point, the shield work was entirely suspended and the arch section was concreted in. In placing this portion of the arch, work was started at a point about half way across the river and the concreting was carried on in both directions. The first 400 feet of siphon tunnel was now completely concreted, except for the slab, and the mining was resumed. After this the concreting and mining were done alternately, each being carried on under the most favorable circumstances. The last 150 feet of concrete work was done in free air, since that portion of the tunnel was open to the riser shaft; the remainder of the concreting was done, however, under compressed air.

A ½-yard motor-driven mixer, stationed directly at the top of the drop shaft, delivered the concrete into collapsible cars, which were lowered by the shaft hoist, run through the material lock and into the tunnel. For the 150 ft. of open tunnel a mixer was placed at the top of the riser shaft and the concrete was delivered to the cars below by means of a chute. A 1:2½:4½ mix was used throughout. The information contained in this article is due to Municipal Engineering.

Judgment Regarding Montreal Aqueduct Controversy

Mr. Justice Bruneau, in the Practice Court, Montreal, has dismissed the petition of Mr. J. E. Borque, acting for the Citizens' Association, for an interlocutory injunction restraining the Civic Board of Control from putting into effect a resolution cancelling the contract with the Cook Construction for widening the aqueduct. Part of the work has been done, and the controllers and the Cook Construction Company have agreed to arbitrate the claims and counterclaims. The judge held that the cancellation of the contract was purely one of administration and that, as the controllers had authority to pass the contract, they had also authority to annul it. No allegation of fraud or malversation in the cancellation had been made, nor had the petitioner shown any particular interest in preventing the cancellation of the contract.

Low Maintenance on Toronto-Hamilton Highway

The second year of maintenance on the Toronto-Hamilton concrete highway closed October 31, 1917, and the results only serve to emphasize the conclusions that could have been drawn last year. When the Commission is freed from the excessive cost of maintaining the short stretches of macadam at bridge approaches the cost of repairs to the road surface will be almost negligible. On 312,100 square yards of concrete (approximately 30 miles) the Commission spent in 1917 on tarring cracks and joints a total for labor and materials of $767.70. This result is extremely favorable when contrasted with a cost of $5,932.12 for repairs to 7,900 square yards (approximately ¼ mile) of macadam.

Suitable Foremen for Halifax Reconstruction Being Listed

At the request of the Halifax Reconstruction Committee the Montreal Builders' Exchange is cooperating with the committee in the plans for rebuilding the ruined districts. The Exchange has obtained a large number of names of superintendents, foremen, timekeepers, etc., of the various sections of the building trades with a view to their employment at Halifax. The qualifications of these men have also been ascertained, and the list forwarded to Halifax. The manager of the reconstruction committee, Col. R. S. Low, has written expressing his appreciation of the assistance of the Exchange and of the offer to aid in any way which may be desirable.

Fig. C 21. Mantel Clock

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The Lachute Shovel Company have at Lachute Mills a plant for treating timbers with carbolineum.

It is reported that the military authorities have been requested to establish a fully-equipped hospital of 250 beds in Regina, Sask., at the earliest possible time.

The Bloor Street Viaduct has finally passed into the hands of the city of Toronto. The contractors' work on the structure has been completed and there remains only the paving of the roadway and the laying of car tracks to be carried out.

At a recent meeting of the council of Wellington County, Ont., the treasurer's report showed that since January last $38,237.50 had been expended on county roads, $4,748.22 in towns and villages off county roads, $1,070.62 on road machinery, a total of $46,855.25.

The Pacific Construction Company, which is conducting shipbuilding operations at Port Coquitlam, B.C., expects to have vessel No. 20 ready for launching by the end of February or the beginning of March. Ship 21, which has, under the contract, a longer period for construction, is also well advanced. The steel keelson has been placed and the fastening work is being pushed rapidly ahead.

The council of Lanark County, Ont., has decided to carry out no new road construction next summer. Maintenance work will, however, be taken care of and a new structure is to be built to take the place of the present McIlquham bridge. The tender of the Ontario Bridge Company for the steel work on this bridge has been accepted and the piers and concrete floor are to be constructed by the county commissioner.

The sewer system at Trail, B.C., now just about completed, comprises upwards of 20,000 lineal feet of sewers, with 70 brick-laid manholes. The J. E. Broley Company were the general contractors, but the latter part of the work was taken over by Victor Bianco, who constructed some 7,300 feet of the sewer. In connection with the waterworks system, work on the distribution reservoir, which is to hold 1,000,000 gallons, has been discontinued for the season, but will be completed in the spring. The plans of the engineer call for a by-pass from Cambridge Creek, around the reservoir, and this is now being used in bringing the new water supply to the old and new city mains. Mr. A. L. McCulloch is engineer for both the sewerage and waterworks systems. The contracts, however, are separate.

Obituary

Professor Clement Henry McLeod, of McGill University, who was well known to engineers all over the Dominion as the former secretary of the Canadian Society of Civil Engineers, died on December 26 while seated in his office at the University. Professor McLeod was 66 years of age, and was born at Strathlorne, Cape Breton. In 1873 he graduated from McGill and since then had attained prominence in the University and held important offices. He was professor of astronomy, of surveying and of geology, and vice-dean of the Faculty of Applied Science, also formerly having held the position of professor of civil engineering. He was a charter member of the Canadian Society of Civil Engineers and had been secretary since 1891 up till the beginning of 1917.

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Get Government Recognition for the Engineering Profession

OUR new Union Government is undoubtedly giving evidence of ability to tackle big problems, act promptly and back up their decisions with vigor and firmness.

One big problem with tremendous possibilities not only for shortening the present struggle, but for making it possible that Canada should assume a prominent place in the constructive period that must follow the war has apparently been overlooked.

This problem is: What is the value of the engineering profession to the nation?

For the technical man, the man who knows of the work the engineer has accomplished during the past three and a half years in Europe, the question answers itself. Is it possible the public does not recognize the truth, or that our government is blind to the fact that the work of technical men has been the pivot about which all the operations of the other elements in the war have centered? Imagine for a moment the elimination of the engineer from the operations in France! The war would end overnight.

In spite of this, our government is doing nothing to conserve this profession. Trained for a specific work, engineers are being drafted into the infantry ranks. Students with half-completed courses are being refused exemptions to complete their special training. No extra encouragement is being given our youths to fit themselves for this necessary work—indeed, the anticipation of being called to the colors in the middle of their course is deterring many young men from entering our engineering colleges at all.

Isn't the government waiting for someone to give them a "lead"? The average elector won't do it for the simple reason that he doesn't understand. The colleges can scarcely do it for fear of being accused of self-interest. It falls then—and rightly, we think—on the engineering profession as a whole—the Canadian Society of Civil Engineers, with its 3,000 members; the various societies covering the mining, chemical, electrical, and mechanical technical fields; and the various provincial sections of the Joint Committee of Technical Organizations.

If the engineering profession in Canada is to uphold its reputation for effectiveness and efficiency; if it is going to establish its identity as a powerful influence during the war, and as an essential element in the reconstruction which will follow the war, these societies must surely act promptly, vigorously, and co-operatively.

Be Prepared for Reconstruction

WE are just entering upon the fourth New Year which has found the world embroiled in the terrors of warfare; and, though there is still no lifting of the cloud, it would seem that the nations are straining their eyes for the first signs of the coming of peace. All our "wise men" and "seers" have been prophesying as to its advent, but we only know that it must come—not how or when. And with peace comes reconstruction and adjustment — reconstruction of the homes, the factories, and the towns which war has devastated, and adjustment of the economic and industrial conditions which it has overthrown. Thus the cessation of hostilities can bring little or no relaxation of effort, for the problems which will then confront the world will demand as much energy and determination and as thorough organization as we are throwing into the present struggle. Therefore, we must be prepared to direct all our forces in this new direction, else we may find ourselves overwhelmed by the rising tide of totally unprecedented economic conditions—conditions regarding which we can only hazard a guess.

One phase of the problem, in which the readers of the Contract Record are particularly interested, is the probable demand on the constructional organizations of Canada. This question is one probably to which no definite answer can be given until the time comes, but investigation would no doubt shed some light upon it. Great Britain is already making her preparations along this line, and a national housing and town planning council has been formed. In the Contract Record of December 19 there appeared an item regarding the work of this council and its recommendations as to the types of houses which would be required. In our present issue, also, we have made further mention of the plans of the British Government for after-the-war construction work. The authorities in the Old Country feel that their facilities for building work will be taxed to the utmost, and they are already organizing their forces to meet the situation. Would it not be the part of wisdom for Canada to take similar action?

At the present time there is a shortage of housing facilities in many localities, and there is very little building work going on. During this year it is to be expected that the demand will grow greater, but those who have money to build with are holding off till "after the war." When that time comes and several hundred thousand soldiers return to civil life and to their homes, will the supply be at all adequate to the demand? Is there not a danger, almost a certainty, of congestion? Then, what will be the result? Just this, that an undertaking which demands thorough organization and systematizing will be left to the speculative builder and controlled largely by the real estate manipulator, resulting in a waste of money, time, and material and a more than ever haphazard development of Canada's cities and towns.

There is, too, another phase of the problem which must not be left out of consideration, and that is the question of immigration. It is scarcely safe even to hazard an opinion as to whether Canada may expect a large increase in population from this source when hostilities are over. It is well to remember, however, that Canada has been advertised, tremendously advertised, by the deeds of her soldiers on the European battle fronts, and as an inexhaustible source of supplies. Great Britain and her allies have been hearing more and thinking more of this Dominion in the last three years than they ever did previously. And this advertising may be more effective than anyone has imagined in attracting emigrants from a devastated and war-weary Europe to the big, free country across the sea.

There really seems only one thing to do, and that is —be prepared—for it is better to be prepared for an emergency that never arises than to take the chance of meeting an emergency without preparation. The situation calls for action on the part of the government. Also the building and engineering organizations of the country must be fore-warned and fore-armed, and these, all working together, should have their plans so laid as to provide for a systematic development of Canada's cities and towns. Close co-operation between immigration officials and local governing bodies will be required, and care must be taken in the selection of the types of houses erected so as to provide for the different classes of population. No precautions should be neglected, else we may find ourselves helplessly encumbered with the slum and the tenement system.

This year upon which we are entering may see—as we all devoutly hope—the termination of the war. Therefore, let us begin now, so as to be ready when it comes. We were unprepared for war; let us not be equally unprepared for peace.

The Housing Situation in Great Britain

THE British Government, acting through committees appointed by the Local Government Board and the Ministry of Reconstruction, is taking definite steps to facilitate the provision of adequate housing for the industrial classes at the close of the war. It is realized that there are great difficulties to be overcome and that there should be no delay in tackling the situation. Even before the war a shortage of workmen's cottages, especially of the better class, had begun to manifest itself in many localities, and, since hostilities commenced, private building has, of course, practically ceased, owing to the difficulty of obtaining labor, the high prices of material, and the restriction imposed, in the national interest, on all undertakings costing more than $500 or involving the use of constructional steel.

As a result, it is estimated that the number of workmen's houses in urban and rural areas has already fallen short of normal requirements by some 200,000. During 1918 this figure will in all probability rise to 300,000, and some authorities even go so far as to say that if adequate provision is made for the natural increase of population, and the dilapidations of the last three years, schemes will have to be laid out for at least half a million cottages.

In view of the high prices likely to rule for some time after the war, it cannot be left to private enterprise to grapple with a problem of such magnitude. During the reconstruction period it will be necessary to rely far more than formerly upon local authorities, to provide not only the cottages required, but the roads, the water supplies, and the drainage incidental to them. Recognizing this, the government has announced its purpose to give substantial assistance from public funds to such public bodies as are prepared to deal in an adequate way with the situation which has arisen in their particular areas. In this way financial difficulties in the main will be overcome.

In order to deal with the question of providing the necessary materials, so that this factor of the case may cause no delay, a building materials committee has been appointed by the Minister of Reconstruction, under the chairmanship of Mr. J. Carmichael, chairman of the Munition of Works Board. This committee will ascertain what supplies are available, not only for housing, but for all purposes, and will report how these may be increased in order that building operations may be commenced promptly at the close of hostilities.

First "Emergency" Ship Launched

The Foundation Company, on December 27th, launched the first of the ships outlined on the Imperial Munitions Board emergency shipbuilding program. Last spring the I. M. B. placed several orders for wooden ships, and these are being constructed in many different parts of Canada. The ships are rated at approximately 2,500 tons, and have a length of 250 ft. and a beam of 43 ft. 6 in. The elapsed time from the breaking of the ground to the launching of this ship was approximately six months, which bears testimony to the ability of Canadian organizations to come to the assistance of their country in these times of emergency. The Foundation Company's shipyard is in charge of W. I. Bishop, who is well known in the contracting and engineering field in Montreal and Toronto. His many friends will be pleased to know of his success in the new enterprise.

To Enquire into Canada's Resources

It is announced from Ottawa that active steps are being taken by the Reconstruction and Development Committee, of which Hon. A. K. MacLean, is the head, to institute a full enquiry into the country's resources and their immediate development. Mr. MacLean has been raised to the full rank of cabinet minister.

The Toronto Section of the American Institute of Electrical Engineers was addressed on December 21 by Charles H. Riches on the subject, "The History and Development of Patents."

Tower Travellers of Gantry Crane Type Used to Erect Quebec Bridge

Details of Devices that Handled and Placed Steel for the Entire Structure—Each Traveller Equipped with Two Large Capacity Cranes and Four Derricks

By A. J. Meyers*

To erect the main bridge material, tower travellers of the gantry crane type were used. The height and range of travel of these machines and their equipment of cranes, derricks, and auxiliary hoists were such that all the members of the cantilever systems were handled from the carrying trucks on the main bridge floor and placed into final position in the bridge, sometimes in pairs and sometimes singly, entirely by this means. These travellers, of which there were two—one for use on the north shore and the other for use on the south shore—were carried between the main bridge trusses on runways, located at the elevation of the bridge floor. On the anchor arms these runways were carried on special staging, placed between the falsework bents which supported the anchor arm trusses. On the cantilever arms they were carried entirely by the permanent bridge floor and the trusses of the cantilever arms.

The inside type of gantry crane traveller adopted was given the preference over the outside gantry crane traveller and over the top chord traveller sometimes used in the erection of cantilever bridges, because this inside type offered distinct advantages both in economy of erection material and ease of operation. The girders used for the runways were mostly part of the permanent bridge floor, and, having once been placed, did not have to be handled again. The entire control of the traveller equipment was located practically at the centre of operations, greatly facilitating supervision and the transmission of orders while handling the heavy truss members.

General Description of Traveller

As shown in Figures 1 and 2, the body of each traveller was a structural steel tower, about 190 ft. high over all, divided vertically into six tiers, with horizontal bracing on floors at the tier division points. The horizontal cross-section of the middle portion of the tower was a rectangle, 54 ft. by 37 ft. on side measurement and the vertical bracing in each tier of this middle portion was double intersecting on all four sides of the tower. The base or lowest tier of each traveller was made up of two Warren trusses, 23 ft. 3 in. deep, running longitudinally, parallel to the trusses of the main bridge and projecting to the rear to a total length of 90 ft. This tier was braced transversely with portal and lateral bracing, designed to allow derrick cars and material trains to pass on the two railway tracks underneath the main tower. These cantilever base trusses supported the main tower, and were carried on four six-wheeled trucks, running on double lines of rails, 6 ft. 6 in. centre to centre for each truck, the centre to centre distance of double tracks being 54 ft. and the length of wheel base on each track being 65 ft. 11 in.

The top or uppermost tier of each traveller consisted of a pair of trusses of the sub-vertical Warren truss type, running longitudinally and cantilevered out beyond the main tower, a distance of 57 ft. front and rear. These trusses were 18 ft. deep and 155 ft. long. They were braced transversely in vertical and horizontal planes, and served as runways for the two travelling cranes above. From the base of the traveller runway rail to the top of these upper travelling cranes the completed traveller was 210 ft. high, and weighed in working condition 920 tons.

Two Travelling Cranes and Four Derricks

Each traveller was equipped with two upper travelling cranes, each crane having a longitudinal travel on the top chord of the upper trusses of 119 ft. 3 in. These cranes were cantilevered out transversely beyond the tower of the traveller a distance of 29 ft., giving a total length of crane of 112 ft. between the end stop channels for the auxiliary gantry cranes, and they were designed with two 55-ton hoists each, which could work separately, in pairs, or all four together, in handling the heaviest bridge members. At each extreme end of a crane was located a small auxiliary gantry crane which travelled with the main crane and formed part of its equipment. These small gantry cranes were designed for a maximum lift of 10 tons on two 5-ton block and falls, and were used for handling the pin-driving and riveting cages.

Approximately 100 ft. up from the base of the traveller runway rail, seats for four 70-ft. 20-ton derrick booms were located, one seat at each of the four corners of the main tower. The ordinary working length of these booms was 70 ft., but in case of necessity the two front booms could be lengthened to 90 ft., in which case the seat of the boom was lowered 36 ft. to the floor below, provision having been made to accommodate the booms at these points.

As shown in Figures 1 and 2, the derrick hoists and operating machinery were placed on the second and third floors of the traveller. These floors, where the control for the hoisting and operating machines for the whole traveller was located, were the working floors for the operators. The controller house, which contained the switchboards, main hoist magnetic controllers, and resistances, was situated just underneath floor 2, to the rear of the traveller. Communication between the top and bottom of the traveller and the several intermediate floors was attained by means of an electrically-operated elevator and stairway encircling the elevator shaft, located in the centre of the rear face of the traveller, and also by a system of field telephones which thoroughly connected up the different fields of operation.

Transferring Load to Trucks

Each supporting truck of the traveller had six truck wheels, three for each rail, spaced at 4 ft. 6 in. centres longitudinally, giving a wheel base for each truck of 9 ft. The details of one truck are shown in Fig. 5. When the traveller was in motion along the bridge floor the two top travelling cranes rested to the extreme rear of the upper trusses, giving a condition of almost equal distribution of traveller dead weight upon the four trucks. The reaction taken by one front truck under these conditions was 486,000 pounds. This 486,000-pound truck reaction was transferred from the bottom chords of the trusses through a 6 in. diameter pin to a longitudinal box girder, located between the web of the truss chord, with built vertical hangers riveted into the ends. These hangers distributed the load to transverse box girder beams through two 6 in. diameter pins at right angles to the pin connecting the truck to the bottom chord of the trusses. The transverse box girder beams were riveted to four vertical diaphragms projecting up from the two longitudinal box girders which transferred the reaction to the truck wheels.

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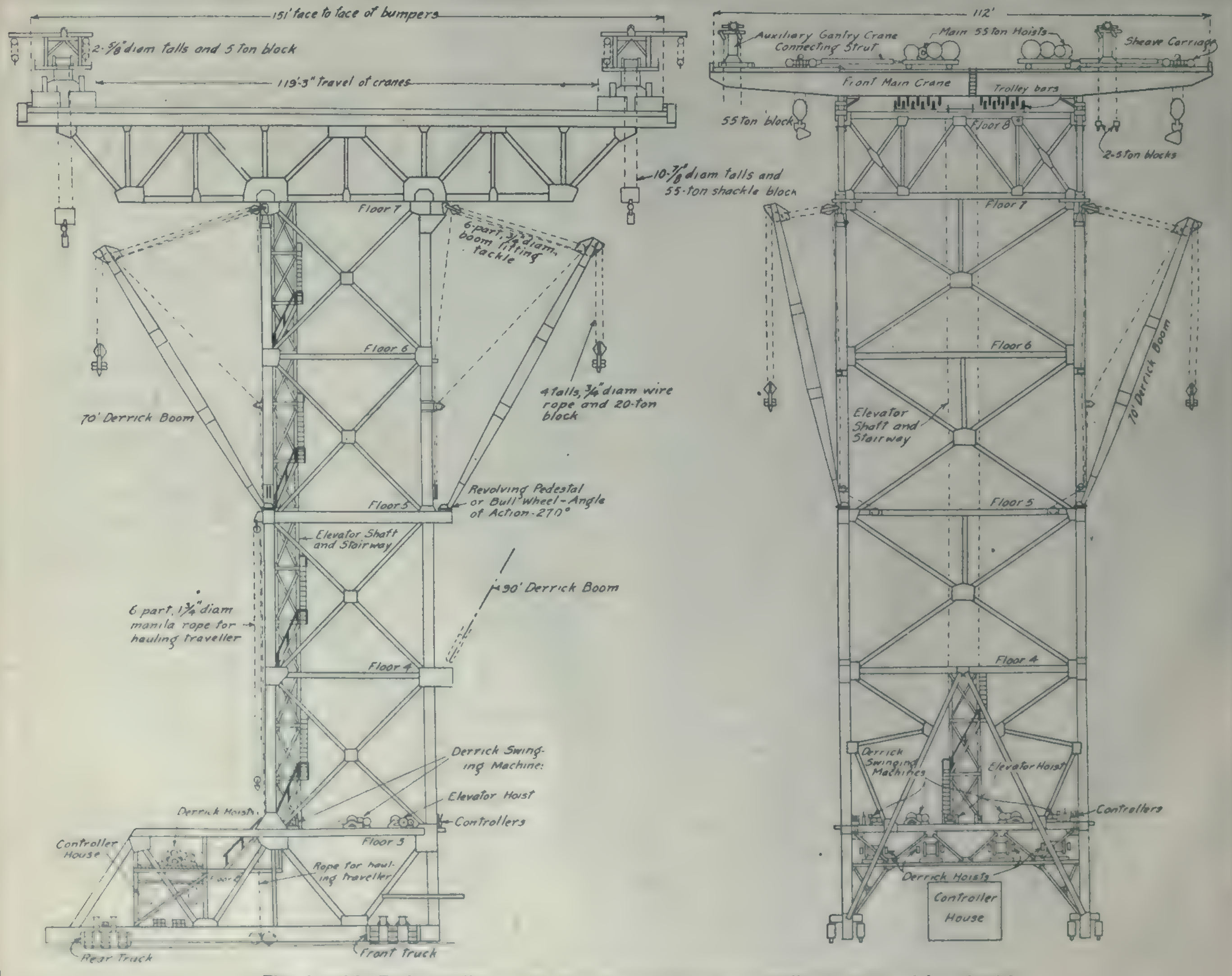
* Chief Draftsman, Board of Engineers, Quebec Bridge.

That portion of the reaction taken by each one of the six truck wheels was transferred from the box girder to the wheels by means of four helical car springs. These springs each carried a load of 21,000 pounds while the traveller was in motion, but were designed to take a load of 30,000 pounds each before they would compress to their solid height. The use of these car springs and having the 6-inch connecting pins arranged at right angles to each other, as shown, insured that the truck reaction would be taken concentrically and symmetrically, and would be distributed equally over the six truck wheels, even if the traveller runways were somewhat uneven or out of level—a condition which could not be avoided.

Upper Runways Kept Horizontal

On account of the floor of the bridge being on a grade, which varied in inclination to the horizontal as the bridge was erected panel by panel, it was necessary to make provision for keeping horizontal the plane of the top chord of the upper trusses, which carried the main travelling cranes. This was accomplished by making the connection between the bottom chords of the lower trusses and the rear trucks of the traveller adjustable, by using, as shown in Fig. 5, two 5-inch diameter vertical bolts to transfer the reactions from the traveller to the trucks. The distance from the centre line of the bottom chords of the lower trusses to the base of traveller runway rail could be changed by moving the top travelling cranes to the extreme front of the traveller, thus reducing the dead load reaction on the rear trucks to a minimum and enabling the cast steel nuts at the upper ends of the 5-inch diameter bolts to be turned and the rear end of the traveller raised or lowered as desired, in order to bring the runway for the upper crane girders into a horizontal plane.

Provision was also made at the rear end of the bottom trusses to anchor the traveller to the floor girders whenever the traveller was lifting the heavier bridge members with the travelling cranes in their forward position, and whenever the traveller was lifting with these cranes to the rear, shims were driven between


151' face to face of bumpers
2-5/8" diam falls and 5 ton block
119'-3" Travel of cranes
10-7/8" diam falls and 55-ton shackle block
Floor 7
6-part, 3/4" diam. boom lifting tackle
Floor 6
4 falls, 3/4" diam wire rope and 20-ton block
70' Derrick Boom
Revolving Pedestal or Bull Wheel-Angle of Action-270°
Floor 5
Elevator Shaft and Stairway
90' Derrick Boom
6 part, 1 3/4" diam manila rope for hauling traveller
Floor 4
Derrick Swinging Machine:
Elevator Hoist
Derrick Hoists
Controllers
Controller House
Floor 3
Rope for hauling traveller
Rear Truck
Front Truck
112'
Auxiliary Gantry Crane
Connecting Strut
Main 55 ton Hoists
Sheave Carriage
Front Main Crane
Trolley bars
55 ton block
Floor 8
2-5 ton blocks
Floor 7
Floor 6
Elevator Shaft and Stairway
70' Derrick Boom
Floor 5
Floor 4
Derrick Swinging Machines
Elevator Hoist
Controllers
Derrick Hoists
Controller House

Figs. 1 and 2—Each traveller is a six-tier tower with two top travelling cranes and four derricks.

the ends of the trusses at the rear and the supporting floor girders so as not to overload the rear truck springs. Under all working conditions the truck springs, both of the front and rear trucks, were locked at a height of spring which allowed the springs to take only a reaction equal to that which they carried while the traveller, with the top travelling cranes to the extreme rear of the upper trusses, was moving from one operating position to another. The front and rear reactions from the loads lifted were always taken care of by shimming between the traveller bottom trusses and the supporting floor girders or by anchoring the rear of the traveller against lifting.

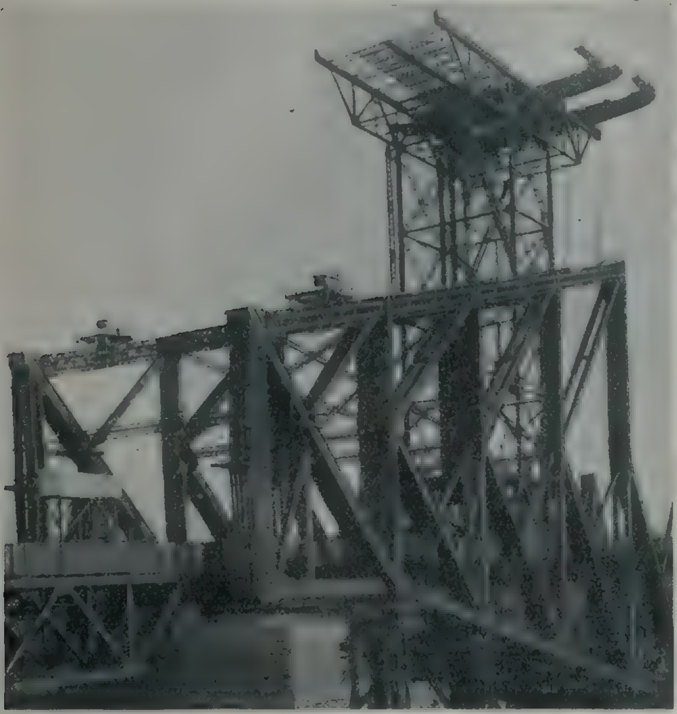


Fig. 3—View showing traveller on its last trip to the main pier, placing the upper web members and the upper bracing of the north anchor arm.

Four 70 ft. Booms Handle Small Material

About 100 ft. up from the base, on the fifth floor of the traveller, were located the four 70-ft. 20-ton booms. These booms were used for handling the smaller material, such as sway and lateral bracing and floor material, and also pin-driving and riveting cages. They were built of four 6 x 6 x ⅜ in. angles, latticed, the outside dimensions of the cross-section at the centre of the boom being 3 ft. x 2 ft. 6 in. back to back of angles. Both ends of the booms were tapered to a bevel of 1½ in. in 36 in. At the upper end three sets of sheaves were provided to accommodate the four-part ¾-inch diameter wire rope tackle of 20-ton lifting capacity, and one set of sheaves to accommodate the six-part ¾-inch diameter top lifting tackle which operated the boom. At the lower end the booms were pin-connected to a revolving pedestal or bull wheel, having a horizontal angle of turning of 270 degrees, allowing the booms to operate in any position from the horizontal to the vertical, on two adjacent faces of the traveller. The front booms and their revolving pedestal were moved to seats on the fourth floor, 36 ft. 9 in. lower down, whenever it was found necessary, in placing material, to increase the reach of the boom from 70 ft. to 90 ft., by inserting a boom section 20 ft. long in the middle of the length.

Derricks Operated Electrically

These derricks were operated by four electric hoists, located on the second floor of the traveller. Each hoist was driven by a 51 h.p. 220 volt d.c. motor, with drum type controller and resistance necessary for hoisting, having a speed of 295 r.p.m., and geared to give a lifting speed under full load of 37 ft. per minute. These hoists were designed for a rope pull of 10,000 pounds with eight layers of ¾-inch wire cable on a drum. The two drums were each 15 in. diameter and 31 in. long, and were furnished with a differential brake band and a patent automatic brake on the pinion shaft strong enough to hold the maximum load. Each hoist had four spools 12 in. in diameter and 15 in. long, each spool being loose on the shaft and provided with sliding steel jaw clutch, operated by hand lever with latch and quadrant.

Each revolving pedestal or bull wheel of a boom was operated by 5 h.p. 220 volt d.c. motor, 700 r.p.m., located on the third floor of the traveller, and geared to give a rope speed of 25 ft. per minute with a maximum pull of 6,000 pounds in the rope. This motor was fitted with a mechanically-operated brake on the extended armature shaft. The use of this brake was to block the machine at night or when not in use. The motor was furnished with a reversible controller and the necessary resistance.

Pair of Travelling Cranes Handle Heavy Members

Travelling longitudinally, with the top chords of the upper trusses of the traveller as runways, was a pair of transverse cranes, equipped to handle the heaviest members in the bridge, as shown in Fig. 6. Each of these cranes was built of two single webbed plate girders 5 ft. 6 in. deep and 113 ft. 4 in. long, spaced 8 ft. 6 in. centre to centre, and braced together for that portion of the crane, beween the runway trusses, with top and bottom laterals and vertical cross frames. Beyond the runway trusses the main girders cantilevered out on each side of the traveller a distance of 29 ft. 8 in., or far enough to command the vertical planes of the main bridge trusses.

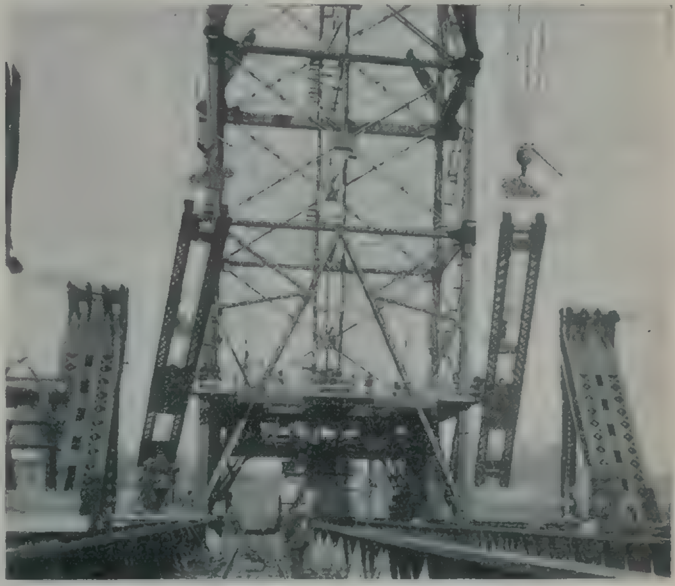


Fig. 4—Traveller hoisting and placing the corresponding members of the east and west trusses of the north anchor arm at the same time.

These cantilevered portions carried between the main crane girders two runway girders 36 in. deep by

25 ft. long, spaced symmetrically about the longitudinal axis of the cranes and 3 ft. 11 in. apart, and framing into two cross plate girder diaphragms, one at the end of the crane girders and the other at the point of runway support. On these smaller girders were placed the runway rails for the sheave carriage of the 55-ton hoist. These sheave carriages travelled longitudinally on these runway girders when handling material from the loading cars on the main bridge floor to the final position in the main bridge trusses. These girders were braced to the main crane girders by intermediate cross frames, but a space of 2 ft. 10 in. between the girders was left clear for the full length of 25 ft., to allow for the longitudinal travel without obstruction of the 55-ton block and tackle of the main hoists.

Two 55-ton Hoists

The two main 55-ton hoists were symmetrically placed about the centre line of the crane girders, and were mounted on a carriage which travelled on cast steel rack rails running along the top flange of the main plate girders. The distance of travel longitudinally was limited to the section of the crane girders between the centre line of the traveller tower and the longitudinal runway trusses. The sheave carriage for the 55-ton block and tackle was connected to the main hoist carriage by a latticed channel strut, pin-connected at both ends, and moved longitudinally with the main hoist carriage at a fixed distance from it. This arrangement enabled the two main hoists of each crane, with their carriages, to be kept always within the two points of runway support for the cranes, giving greater stability to the design. Six 24-in. diameter sheaves were placed in the sheave carriage to accommodate the ten-part ⅞ in. diameter wire rope tackle for the 55-ton block vertically below.

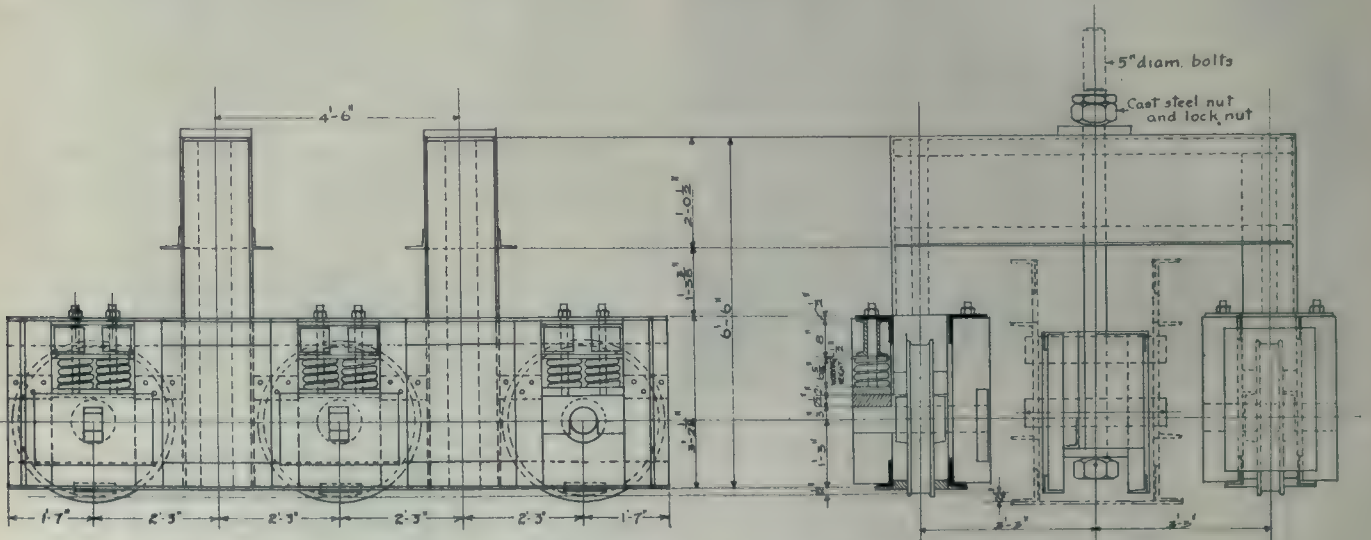


Fig. 5—Details of one rear truck of traveller showing method of adjustment to keep top crane runway horizontal.

The 55-ton capacity block and tackle of each main hoist was operated by one 75 h.p. 220 volt d.c. motor, with a speed of 550 r.p.m. Each hoist was designed to lift a gross load of 120,000 pounds at a speed of 12 ft. per minute, through a double five-part tackle, both ends of the hoisting wire rope being wound on the drums, thus making a rope speed of 60 ft. per minute.

Impossible for Load to Run Away

The controller system was of the magnetic switch type and arranged for dynamic braking, with a minimum lowering speed of 12 ft. per minute. The armature shaft had an automatic disc brake capable of holding the maximum load. It was, therefore, impossible for a load to run away, as, in lowering, the motor worked through a resistance greater than the load carried by the crane. The burning out of a fuse applied the full force of electrical resistance, preventing all motion. In order to guard against attempting to lift loads greater than those calculated upon, special fuses were provided which would blow out when the load reached its maximum. The hoisting drum was divided into two independent sections, separately driven from a second reduction shaft, which in turn was driven through a single pair of cut gears off the back gear shaft of the hoisting motor. One drum was securely attached to the axle; the other was sufficiently loose to insure equal division of the load between the two gears. Each drum was 36 in. in diameter and 31 in. between flanges, and capable of holding five layers of ⅞ in. wire cable.

In case of failure of the automatic brakes on the armature shaft, a hand-operated band brake was furnished on the extension of the back gear shaft of the motor. This brake was of sufficient capacity to stop and hold the maximum load lifted. It was operated by a lever with a locking attachment so that the hoisting block could be locked fast at any point independent of all other brakes.

A 5 h.p. 230 volt d.c. motor, with a speed of 800 r.p.m., was used to move the hoist and sheave carriage along the rack rail. The propelling gear moved the sheave carriage with the maximum load suspended at a rate of 10 ft. per minute, and was capable of holding the hoist carriage against an endwise thrust of 30,000 pounds, due to fleeting loads from the centre of the traveller, but was not capable of moving the carriage against this thrust.

The main shackle blocks, 55-ton capacity, weighed 1½ tons each. They were designed to be self-lubricating. In their highest position these main blocks were 193 ft. above the base of runway rail for the traveller. To prevent over-winding, each main hoist was provided with a Youngstown limit stop, which interrupted the lifting motor current and applied the brake immediately when the block reached the limiting position.

At each end of the main travelling cranes was lo-

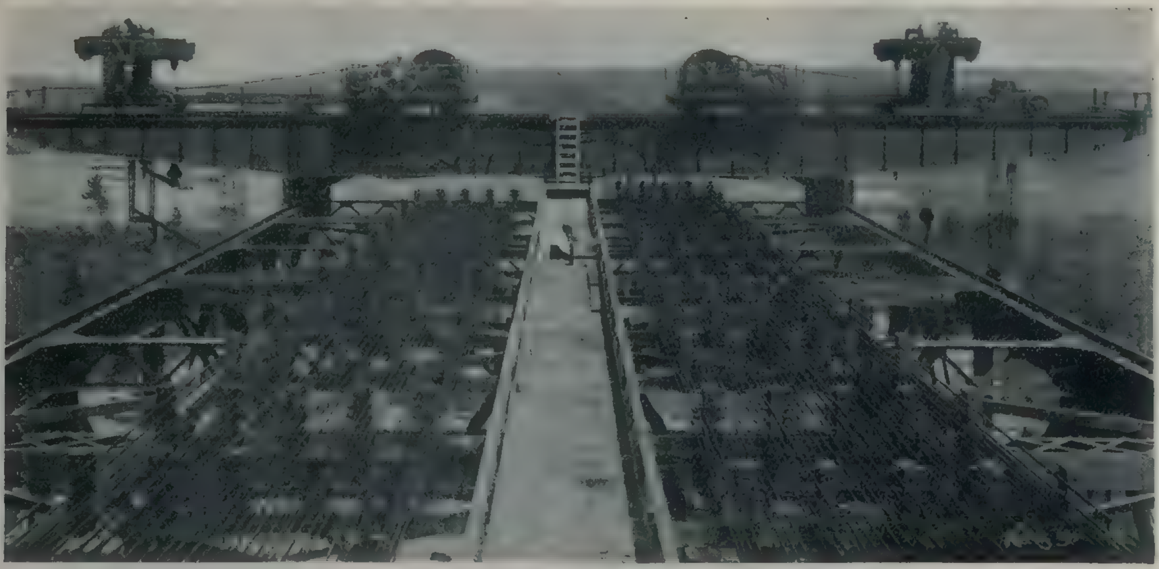


Fig. 6.—View of travelling crane on top runway trusses, showing trolley bars and arrangement of hoisting machinery. These are electrically operated by controllers placed where the operator has full view of the loads being elevated and within easy reach of the foremen issuing instructions.

cated a small auxiliary crane of the gantry type, having an overhang from one support of 2 ft. and from the other support of 9 ft., for the purpose of handling pin-driving and riveting cages. These auxiliary hoists spanned over the sheave carriages for the 55-ton falls, and travelled on eyebeam runways placed on the top flanges of the cantilever section of the main crane girders, having locking wheels underneath the top flange of the eyebeams to keep the gantry in place and to take the uplift from the maximum lift of 10 tons at the end of the 9-ft. arm. Each auxiliary crane was equipped with two 5-ton blocks, which had a transverse travel from end to end of channel runways of 20 ft. normal to the axis of the main travelling crane. They were moved longitudinally on the eyebeam runways by hand power. The 5-ton blocks with two-part ⅝ in. diameter wire rope tackle were controlled by hoists located in the centre of the main crane girders on platforms carried between the bottom flanges. Each hoist had two 16 in. diameter drums, and each drum was operated by a 30 h.p. 220 volt d.c. motor, with a speed of 575 r.p.m., and geared to give a rope speed under full load of 150 ft. per minute.

Crane Trucks

Each main travelling crane was carried on four trucks having two 30 in. diameter wheels per truck, spaced at 4 ft. centres with 3 in. thread, the total length of wheel base on one runway rail being 12 ft. 6 in. The trucks were made of a double web box plate girder 30 in. deep and 7 ft. 6 in. long. Each crane was driven by a 220 volt 16 h.p. d.c. motor, having 725 r.p.m., and

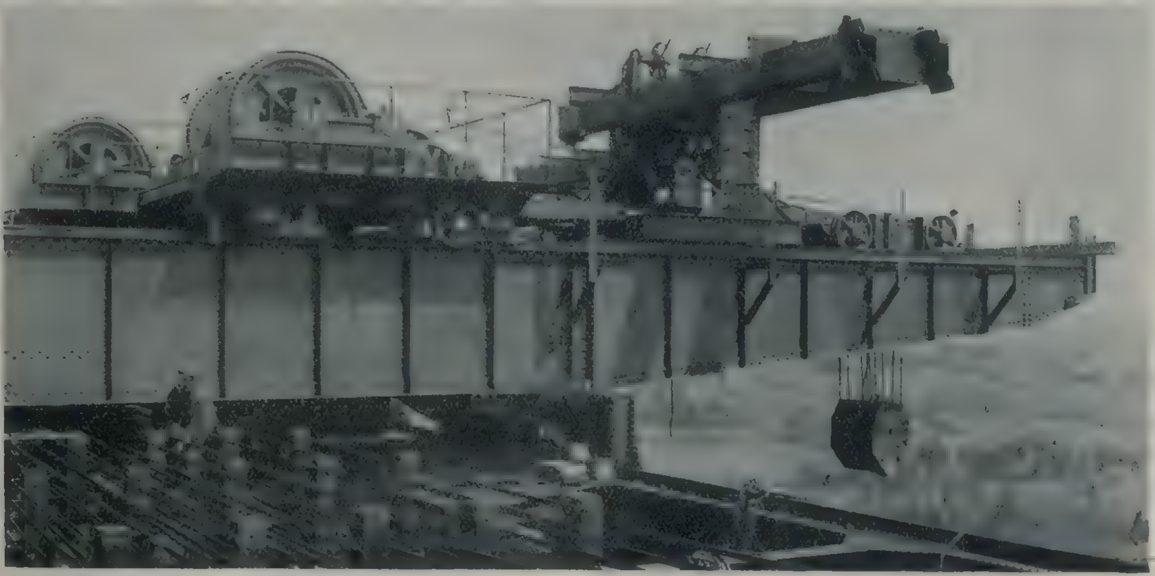
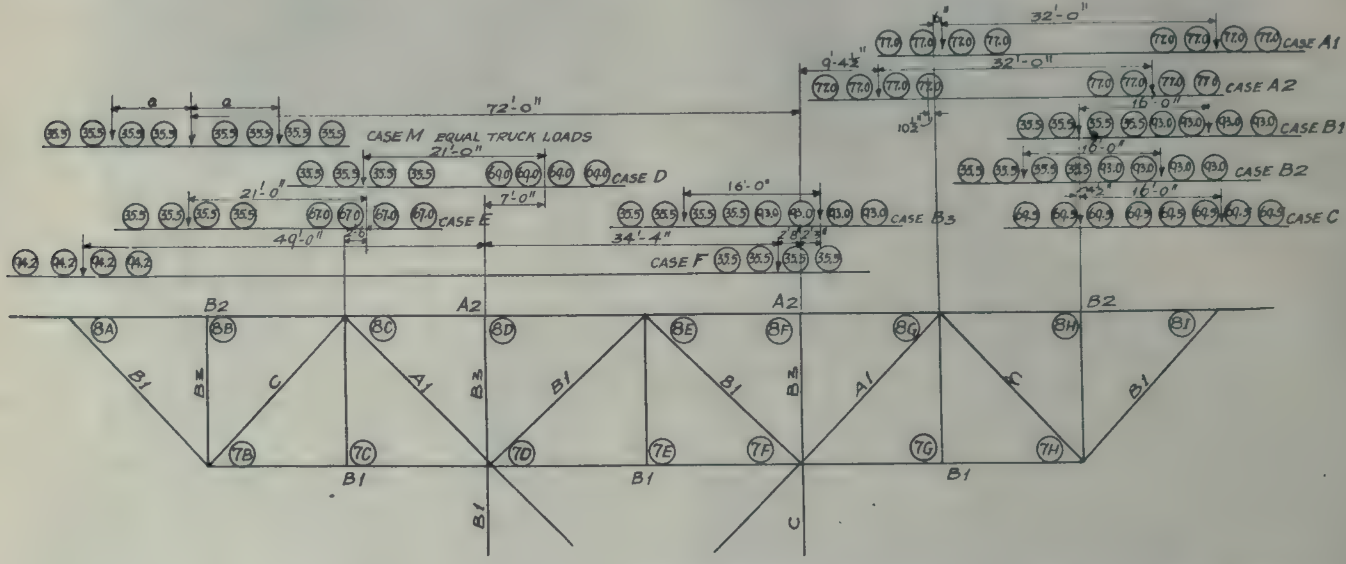
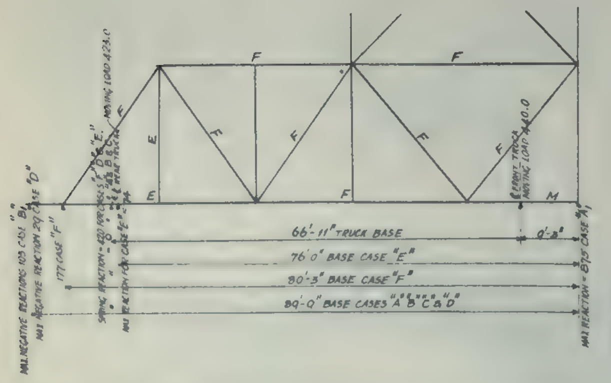


Fig. 7—Showing main 55-ton hoist, auxiliary gantry crane and sheave carriage.

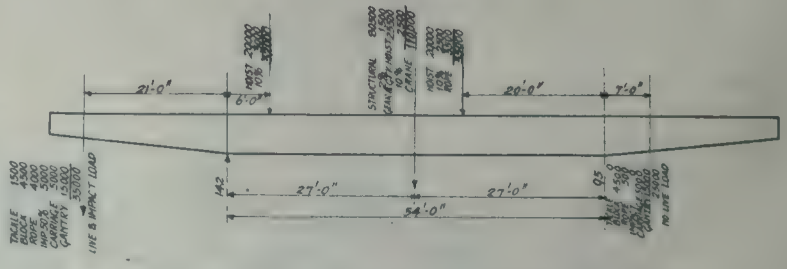
geared to give a traversing speed of 25 ft. per minute when climbing a 1 per cent. grade under full load, estimated at 500,000 pounds, including the weight of the crane itself. The motor was located between the main girders at the centre on a platform on the level of the bottom flange, and the driving power was transmitted symmetrically to the trucks on each rail by gearing and a 3½ in. diameter shaft. Provision was made in this shafting to take down any section without having to remove any other section. Only two truck wheels at each end of a crane were driven. These driving wheels were keyed to their axles, which carried gears on an extension, the other wheels turning loose on their axles.



Wheel loadings for maximum stresses and reactions of travellers. Letters on truss refer to loading giving maximum stresses.



Maximum reactions; letters refer to loading giving maximum stresses and reactions.



Method of loading cranes to obtain wheel loadings shown above; loads in pounds.

While the main cranes were in motion along the runways the contact for the electrical current for the numerous motors was maintained, as shown in Figures 2, 6 and 7, by a system of 20 lines of 1½ x ⅜ in. trolley bars, four tiers deep.

Electric Lift to Connect Floors

The electrically-operated elevator which gave ready access to the different floor levels and working platforms of the traveller was driven by a 15 h.p. d.c. motor, running at 575 r.p.m., and geared to give a full load lifting speed of 75 ft. per minute. The passenger car was supported by two falls of ⅝ in. wire rope, winding one part on a 14-in. drum, and the whole of the machinery was located at the foot of the shaft on the third floor of the traveller. The controller was located in the car, and was arranged for dynamic control. The motor was provided with a solenoid brake.

The traveller was moved a long the bridge floor at a rate of about 10 ft. per minute, by taking hold of the runway girders on both sides of the traveller either to the front or to the rear, depending upon the desired direction of motion, with a 1¼ in. diameter wire rope, which passed through sheaves located in the bottom chords of the lower trusses just below the rear face of the tower. These 1¼ in. ropes ran vertically up and connected to a six-part 1¾ in. manilla rope tackle, one at each rear leg of the traveller tower. The 1¾ in. rope was continuous from the tackle on one side of the traveller to the tackle on the other side of the traveller, and was overhauled by the drums of the derrick hoists located on the second floor. By this arrangement of tackle the pull at the two sides of the traveller was always the same, no matter if one or two hoists were working.

Weight of Traveller Was 920 Tons

The total weight of one traveller, including its complete equipment of derricks and cranes, was 920 tons. The amounts of this weight contributed by the different component parts of the traveller were:

	Tons.
Runway trucks	65
Bottom supporting trusses and bracing	120
Main tower frame, floors, and bracing	170
Wood in floors, etc.	30
Top crane runway trusses and bracing	165
Elevator shaft and stairway	19
Main travelling cranes	210
Auxiliary gantry cranes	36

Derrick booms and tackle	50
Wire and manilla rope (except for main cranes)	8
Electric wiring	3
Derrick hoisting engines	32
Miscellaneous machinery on operating floor 3	12
Total	920

Shims Take Live Load Reactions

When the traveller was being moved from one working position to another, both top travelling cranes were moved to the extreme rear positions and anchored. For this condition of loading the reaction on one front truck was 486,000 pounds, and on one rear truck 450,000 pounds. When the travellers were in operation the weight of the main top travelling cranes was treated as a live load along with the loads lifted by these cranes. Under these working conditions shims were driven at the front and rear of the traveller between the lower trusses and the supporting runway girders and floor-beams. When placing these shims the main travelling cranes were moved into such positions so that the final reactions from the dead weight of the traveller, exclusive of the weight of the main cranes, was 486,000 pounds on one front truck, 36,000 pounds on the front shim reaction, and 165,000 pounds on the rear shim reaction. The rear truck springs were locked at this working height, but the front truck springs were left free, because no negative reaction could possibly reduce the reaction on the front truck below the 486,000 pounds which it carried under moving conditions. Under working conditions the rear of the traveller was anchored to the runway girders in order to take a negative reaction when the main cranes were working in the extreme forward position.

Features of Design

Although in the actual erection of the largest bridge members the members were lifted and placed by the travellers in pairs, one for each truss at the same time, giving a condition of symmetrical loading for the traveller, the traveller itself was designed to lift only one of these heaviest members for one truss at one time, this unsymmetrical condition of loading giving considerably larger stresses and reactions on the side of the traveller carrying the load than would maintain with the symmetrical loading.

The positions of the main travelling cranes and the wheel concentrations for maximum lifts in these positions are shown in Fig. 8. These positions give the maximum reactions and stresses for the traveller and its members. Cases A1 and A2 might have existed when the first section nearest the main pier of the bottom chord of the cantilever arm was erected. This member weighed 160,000 pounds, the weight when lifted being equally distributed between the two cranes and on one side of the traveller. Cases B1, B2, and B3 were for the assumed maximum capacity of lift on one 55-ton block and tackle—that is, 110,000 pounds on one side of the traveller. Case C occurred when lifting the heaviest section of the main shoe, weighing 130,000 pounds, on one side of the traveller, 65,000 pounds being taken by each crane. Cases D and E occurred when placing the compression diagonal members of the anchor arm. In both cases the full weight was taken by the front crane, 65,000 pounds for case D, and 60,000 pounds for case E. Case F occurred when erecting the end compression diagonal of the anchor arm the whole weight of the member—113,000 pounds—being taken by the rear crane.

Impact Proportions

In proportioning the runway girders, supporting floor-beams and staging, 20 per cent. impact was added to the reactions from the load lifted and from the weight of the lifting blocks and tackle. In proportioning the members of the traveller tower and trusses 50 per cent. impact was added to the reactions from the same causes.

Stresses and reactions from longitudinal and transverse wind acting on the traveller were calculated on the assumption of a wind pressure of 30 pounds per square foot on the exposed area of two parallel faces. No wind was assumed to be acting when members were being lifted and placed.

The members of the traveller when being manufactured in the shop were made of such a length that, under the dead weight of the traveller, the front and rear ends of the top runway trusses would be 6.21 inches and 5.95 inches respectively above their geometrical position. This camber was so chosen that the crane track at the loaded end would be approximately level under maximum deflection during operation.

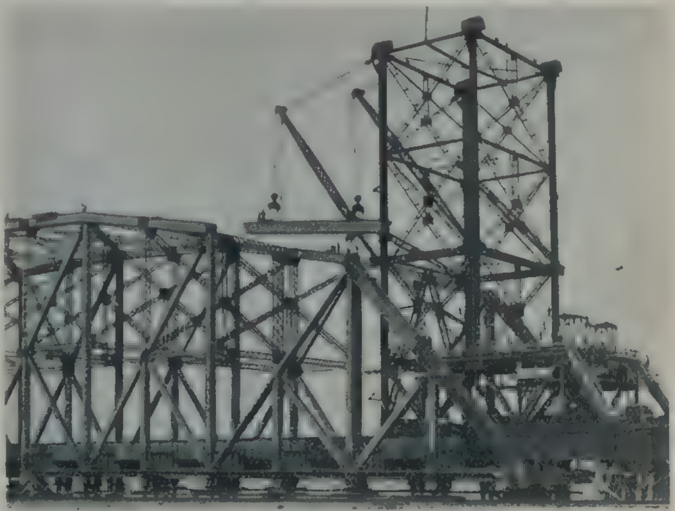


Fig. 9—Traveller completing erection of suspended span. The top runway trusses and main travelling cranes were not needed for this work.

In designing the traveller the unit stresses allowed were: For compression on carbon steel, 16,800 pounds per square inch, for members with l/r less than 50, and 21,000—84 l/r for members with l/r greater than 50. For tension stress on carbon steel and for extreme fibre stresses in bending in girders and beams 21,600 pounds per square inch was used, and for shear in the webs of plate girders and beams 12,000 pounds per square inch. Wherever nickel-steel was used these allowed unit stresses were increased by 40 per cent.

Nickel-Steel Reduced Weight

In order to reduce the weight of the completed traveller as much as possible nickel-steel was used for the main material in the main traveling cranes and the top runway trusses. The material in the main tower and the lower supporting trusses and all the bracing was of carbon steel.

The largest stress in the tower columns was 1,299,000 pounds, demanding a carbon steel section of 79 square inches. This member was made up of two 24 x ¾ in. plates and four angles 8 x 6 x 13/16 in. latticed. In the runway trusses at the top of the traveller the largest stress in the top chords which carried the runway rail for the main cranes was 1,344,000 pounds axial, increased by a bending moment of 340,000 ft. pounds where the chord was continuous over the panel points. This section was made of nickel-steel plates and angles of the box section type with cover plate on the top flange and latticed on the bottom. The bottom chord and all the web members of these trusses were built of a nickel-steel H section, made up of four angles and one plate. The members of the lower supporting trusses, except the verticals, which were H section, were all of the box channel section type, latticed on two sides, and made of carbon steel plates and angles. The flanges of the web members were turned in, but the flanges of the chord members were turned out. All the connections for the members of the traveller were riveted except the connection for the top trusses to the main tower columns, where 10 in. diameter pins were used.

Erection of Travellers

The north shore traveller was erected on special supporting girders on shore, just clear of the abutment, the top of these girders being in line with the girders carrying the traveller trucks on the bridge. The erection of this traveller started on November 8, 1913, was proceeded with during the winter of 1913 and 1914, and was completed on May 18, 1914. The members of the two lower tiers were placed into position by means of a derrick car, while the upper tiers were erected by using a derrick boom and mast stayed to the four corners of the tower. This derrick was moved up from floor to floor as the erection of the tiers proceeded.

The north shore anchor arm was erected by the north shore traveller during the season of 1914. On August 5, 1914, the erection of the south shore traveller was begun. Work on the erection of this traveller was proceeded with slowly during the remainder of the summer of 1914, and during the following winter, the traveller being completed on May 12, 1915. During the season of 1915 the north shore traveller erected the north shore cantilever arm and the south shore traveller erected the south shore anchor arm. The north shore traveller was then taken down and moved to the erection site of the suspended span, where it was re-erected, with the top trusses and travelling cranes left off, the work of erecting the suspended span being done by the four 70-ft. 20-ton booms. The first suspended span was erected by this traveller during the season of 1916, while the south shore traveller was erecting the south shore cantilever arm. The second suspended span was erected by the same traveller during the season of 1917.

Program of Erection

The difficulty of putting in the sway bracing when using the inside type of gantry traveller adopted was overcome in the anchor arms by the program of erection followed. In accordance with this program, the traveller on its first trip from the anchor pier to the main pier erected the inside staging, which carried the main bridge floor material and the extra lines of girders for the traveller track and also erected the outside staging columns which supported the main bridge trusses, sway and lateral bracing of the anchor arm. The main bridge shoes were then erected on the main pier and the traveller moved back to the anchor pier, placing the anchor arm bottom chords and bottom laterals during the trip. The bottom chords being placed, the traveller again advanced to the main pier, without, however, erecting any material. On the second return trip to the anchor pier the truss web members, with their sway bracing, were erected up to the points where the verticals and diagonals intersect, or to a line slightly above the floor line. The portal and the upper half truss of diagonals and verticals, together with the top chord eyebars, were then erected as the traveller advanced again towards the main pier, the sway bracing for the upper half truss being placed by the rear booms of the traveller.

Cantilever Arm Erection

The traveller then proceeded with the erection of the cantilever arm, placing the truss members and bracing below the floor line, with the cranes generally in the forward position and with the front derricks, while the remaining upper truss members and the upper sway bracing was placed by the rear booms and cranes in the rear position as the traveller advanced panel by panel.

All the operations of the traveller were controlled and directed from the third floor. The controllers for all the motors were located on this floor, about 25 ft. above the base of runway rail, or 175 ft. below the crane girders. By this arrangement the operators were in close touch, and had an unobstructed view of all the work being done and could anticipate and promptly execute all orders by the foreman in charge. Each traveller had an operating crew of ten men, six being stationed on the operating platform on the third floor and one on each of the travelling cranes at the top of the traveller.

The Late Professor C. H. McLeod

THE funeral of the late Professor C. H. McLeod, of McGill University, and former secretary of the Canadian Society of Civil Engineers, on Saturday, December 29, was attended by a large number of representatives of McGill, Toronto, and Kingston Universities, Canadian Society of Civil Engineers, and other educational and scientific bodies. The service was held at the Montreal residence of the late professor, and was conductd by the Rev. I. A. Montgomery, pastor of Knox Church. Dr. Symons, vicar of Christ Church Cathedral, and a very old friend of Professor McLeod, was also present, and in the course of a short address paid a warm tribute to Professor McLeod as a scholar, student, and Christian, emphasizing his devotion to whatever branch of work—social and scientific—he applied himself. After the service the body was interred in Mount Royal Cemetery.

Many beautiful floral tributes were sent by various bodies, including McGill and Toronto Universities and the Canadian Society of Civil Engineers, and also by branches of the society in Toronto, Ottawa, and Manitoba.

McGill University was represented at the funeral by Principal Sir William Peterson and a large number of the university staff, many of whom are members of the Canadian Society of Civil Engineers. The latter body was represented by Lieut.-Col. Monsarrat, vice-president; Mr. Walter J. Francis, member of the council; Mr. Fraser S. Keith, secretary; Mr. R. F. Uniacke, of the Ottawa branch; Mr. W. J. Orrock, Prof. E. A. Stone, Queen's University, Kingston; Mr. F. B Brown, and others. The University of Toronto was represented by Prof. H. E. Haultain and Mr. Hugh Vallance, president of the Province of Quebec Architects' Association.

Changes in Highway Design and Construction

Constantly Varying Conditions Require New Methods—Improvements and New Types Induced by Heavy and More Intense Traffic

IN a paper read before the annual meeting of the American Association of State Highway Officials, H. E. Breed, First Deputy Highway Commissioner, New York State, said that conservative people may question the need for many of the recent changes in the design and construction of highways. It is even a frequent reproach to highway engineers that they waste good money in futile experiments, yet the roads that exist today afford only too great evidence of the need of improvements that can come only through change. A condensed review of the paper follows:—

There are legitimate reasons why so many changes are being made. In the first place, engineers are thinking along different lines. Different experiences and different conditions of soil, climate, weight and density of traffic have to be met. In large measure, each man has had to learn through his own experience, and in this process has often repeated mistakes of others, which might have been easily avoided if there had been a more thorough interchange of information. Lack of this results in much duplication of experiments with the consequent waste of money.

Second, the conditions are constantly changing, due chiefly to traffic. The increase in quantity of traffic comprises the natural increase, which each improved road brings to itself, and the further increase that it invites when it becomes a link in a completed system. Today war conditions, military needs, and the lack of adequate railroad facilities force an even greater traffic upon the highways in many localities.

Character of Traffic Must be Considered

And as the quantity of traffic increased, its character also has changed. A few years ago the steel-tired horse-drawn vehicle carrying a load of approximately three tons was the greatest destructive factor. Then came the pleasure car, whose rapid movement made necessary a surface which should be dustless and possess high cohesion. Next, the motor truck of 15 to 20 tons required stronger foundations and heavier types of construction, as well as a greater integrity of surface. And now the steel-tired, as well as the rubber-tired trailers, with greater wheel loading even than the motor truck, must be considered in designing.

Such changes as seem uniformly desirable for all types of pavement are primarily those which affect public safety and commercial expediency. These are: First, depth of foundation. This new and heavier traffic has cut through and broken the old 6-inch waterbound macadam, which for years was thought adequate for all needs. The waterbound macadam roads of the French war front have shown astonishing endurance because they have had such splendid foundations. At present they are being built 2 to 3 feet thick to enable them to carry the concentrated military traffic. This tendency to strengthen foundations can be noticed everywhere, and is unquestionably necessary under the weight and impact of modern high-speed traffic.

Second, more complete drainage. It has been found possible in many cases to render the soil so stable through proper drainage that it is able to withstand the extra loading imposed upon it. In flat country, large ditches as much as a half mile long have sometimes been dug for this purpose.

Banking and Splitting Curves

Third, bank of curves. Objections are raised to this growing practice on the ground that it encourages people to travel at high speed, but the banking of curves certainly makes the roads safer to the careful person driving under strange conditions. In New York State 16-foot roads have been widened or "mooned" so that in many cases where the radius is small the actual curve is as much as 24 to 28 feet wide. Furthermore, this gives an increased range of vision, the super-elevation makes steering easier, and the likelihood of skidding is lessened to a noticeable degree.

Fourth, split curves. Sight distances cannot be secured in some cases where the curve is sharp and dangerous. In order that the traffic might be held to its own side of the road, the curve has been separated and a curbed parking provided.

Fifth, approaches to bridges, to grade crossings, and at intersections. If the grade crossing of a railroad is above the roadway proper, it is safer if the roadway be carried out level for 25 feet or more on each side of the track, so that it may not be necessary to change gears in so dangerous a place. Bridge approaches should have a level stretch of road before the bridge floor is reached, and this should be as long as is economically possible. Street intersections also should be approached as nearly on the level as is possible. Greater safety is secured by cutting the corners to a longer radius.

Sixth, danger signs. To accomplish their purpose, and not be in themselves a danger, these signs should be visible day and night, and should be placed at standard distances from the conditions to which they call attention. There has been a tendency to a more frequent use of guide signs, which in all cases should be large and legible enough to be read easily at the average speed of travel.

In what I have said above, I have interpreted the subject assigned me rather liberally to mean the finished highway. I come now to a more literal interpretation in considering changes in design and construction of specific types of pavement.

Larger Stone for Waterbound Macadam

There has been a general tendency to increase the size of the stone in waterbound macadam, bituminous macadam, penetration method and concrete pavements, from 1½ in. to 2½ in. A larger amount of the product of the crusher is made available, thereby cheapening the cost of the top course stone as well as producing a better surface containing more stone, and having less tendency toward raveling.

A method used during the past few years in the construction of waterbound macadam has been to form the last puddle with light cold tar, or light cold oil. This has the advantage of strengthening the surface bond, as well as making the road dustless.

Calcium Chloride Treatment

Another method is to treat all waterbound macadam with calcium chloride, and give it a surface treatment of light cold tar, or light cold oil. All work that has been properly puddled and bound, and has been opened to traffic for three to six months, should be swept clean, given a surface application of bituminous material, and covered lightly with stone chips or coarse sand. This forms a mat or cushion on the surface, preventing it from disintegration or raveling. Those parts of the surface that are not seasoned enough to receive the bituminous material should be treated with 1½ lbs. of calcium chloride per yard. Later, if necessary, a second application of 1 lb. per square yard should be applied. This will maintain the integrity of the surface until the following year, when the surface can be treated with tar or oil under maintenance.

Vary Methods on Tar and Asphalt

Until the last three years the penetration type of bituminous macadam was built in many cases under practically the same specifications whether asphalt or tar was used, even though asphalt generally stays near the surface, bleeding up in warm weather, while tar has a tendency to work down, leaving no material to prevent surface disintegration. One experiment made to avoid this consequence was made on a road built by the writer. After the proper thickness of stone had been spread it was lightly rolled once to shape it. It was then filled with No. 1 and No. 2 stone in an amount just sufficient to fill the void. The top course was rolled again after which the tar, heated to a temperature of between 200 and 300 degs. F., was applied. The amount of tar for this application approximated 1¾ gals. of tar per square yard for a compacted top course 3 inches thick. The surface was immediately covered with a layer of clean No. 1 and No. 2 broken stone mixed, after which it was again rolled and additional No. 1 and 2 broken stone applied and broomed into the voids until the No. 3 or top course was entirely filled. After this was done, all loose stone was swept from the surface and a seal coat of approximately ½ gal. of tar per square yard was applied. The road was immediately covered with No. 1 broken stone which was spread and broomed, and again rolled. The rolling was continued and additional No. 1 stone added until a smooth, uniform, and thoroughly compacted surface was produced. The first road on which this was tried is now two years old and has been under average heavy traffic. The results are exceptionally good, so that all of our penetration work done with tar will be constructed according to the same specifications.

A Veneer Top on Ordinary Top Course

Another good method of lower first cost where the local stone is not of good enough quality for top surfacing, is to place a veneer top of ¾ inch trap rock, or some other stone of high quality, on the ordinary top course after the first pour of bituminous material is completed. This course should be from ¾ inch to 1 inch thick and poured and finished with the usual squeegee course.

There have been two changes in the mixed surface type of bituminous macadam recently. Where there is to be a large amount of motor traffic less asphalt is used because of the large amount of oil dropped over the pavement by motor vehicles. Another method which has been used to some extent is that of rolling hot stone varying in size from ½ inch to ¾ inch into the surface of a Topeka pavement.

Belt Finish for Concrete

In finishing concrete pavement surfaces the belt has largely taken the place of floating and also of the finishing machine. It is cheaper than either of the other methods and at the same time gives a good, smooth, easy riding surface. The advocates of the roller method claim that, on account of the importance of a proper water content, the roller, if properly used, will not only give a good finish, but also greater strength, taking out the excess water and result in a satisfactory stiff mixture which it is impossible to use in most concrete road construction.

A tendency in brick surfacing that, from an economic standpoint has many advantages, is the use of 3½ or 3-inch brick in place of the ordinary 4-inch paver. In the use of the 3-inch brick there is a saving of ¼ in the freight charges and a consequent saving in handling. This type of work in a number of instances has given every indication of being satisfactory. Some work under consideration may use 2½-inch and even 2-inch brick, and if successful the resulting economies will make brick pavements feasible in many localities where now they are uneconomical.

Laboratory Work to Ensure Good Results

In even this cursory review of recent changes I cannot conclude without reference to the development of laboratory work in relation to road surfacing. There should be laboratory control in connection with every piece of highway work. To insure good work all materials should be up to a standard which has proven its adequacy in service. Field tests by men in charge of the work should be made in parallel with laboratory tests to keep a constant check upon the materials going into the work.

As a matter of cost it may not be entirely practical for every department in its early stages of development to have a fully equipped laboratory, but if there is a sufficient demand for laboratory work, the commercial laboratory in existence would certainly be willing to equip themselves to render this service at a nominal charge. This would stabilize all work, and the amount expended would be the cheapest kind of insurances.

Windsor City Engineer Makes Report

CITY ENGINEER BRIAN, Windsor, Ont., has completed his report for the past year. It shows that Windsor has 45 miles of paving, 43½ miles of sewers, and 125 miles of cement sidewalks. The paving for the past year cost approximately $200,000.

This year's sewer construction included the Gladstone Avenue sewer, which has been completed, and the Parent Avenue sewer, furnishing an outlet for the east end of the city, and which will cost approximately $38,000. The Parent Avenue job will not be completed until the coming spring. In addition to these big trunk sewers, smaller ones, namely, the Louis, Cataraqui, and Montmorenci, the Grove and Jeannette Avenue sewers have been built, costing approximately $20,000.

The bridge at Wyandotte Street and the M.C.R.R.

has been finished. Some excavation work remains and the job of changing the car tracks is yet to be done. The undertaking will not be entirely completed before spring, and it is estimated that the cost of the work will reach $40,000.

The C.P.R. bridge on London Street is estimated to cost $35,000. Thirty-five per cent. of this sum will be paid by the city and the street railway company.

The engineer's report shows that $15,000 worth of new sidewalks have been made during the year, and that eight small alley sewers, built last season, have cost $12,000.

More Adequate Strength Tests Are Needed

Engineering Requirements Call for Less Empirical and Irrational Methods in Determining Strength of Materials

By Henry M. Howe, Sc.D.*

LET me remind you that the practice of our art is still empirical in that most fundamental matter—the strength of the materials which we use, their ability to resist the stresses to which we expose them. It will suffice to touch on two phases of this subject—that our reception tests are quiescent, though in many cases they should be kinetic, and that they do not determine the true resistance of the material even to relative quiescent stress, as it is applied in many important services. Let us consider these two in series.

Should Consider Service Conditions

It should be an axiom that reception tests should represent the most trying service stresses, which in many important cases are kinetic, arising from impact, shock, or very rapid application of stress. This is true of gun hoops, shells, rails, tires, axles, and many parts of motor cars, and of agricultural and other important classes of machinery. The fitness of such materials for enduring these kinetic stresses should be determined primarily by means of impact tests. For each service the severity of this impact should represent the greatest and most rapidly applied stress which is to be expected.

What would you say to using a hydraulic press to determine the ballistic resistance of armor plate or the resistance of a safe to a burglar's sledge? Yet it is only in degree that our present practice is less rational than this, and it is only because familiarity has dulled our sense of incongruity that we do not rebel against its irrationality.

Machines for determining quantitatively the resistance of steel to impact of any desired degree of violence have been on the market for about twenty years, and they have come into use to a considerable extent in Europe for reception tests, though even there they have not received a fraction of the attention which they deserve, so fully has habit blinded us to the irrationality of our present practice. These machines measure quantitatively the energy consumed in breaking a test piece under impact of given violence, and also the capacity of the material for plastic deformation under these same conditions.

Fallacy in Applying Factor of Safety

It is pure empiricism to measure fitness for these kinetic conditions by applying a factor of safety to the results of quiescent tests. Not only must such a factor be a matter of guesswork, but that which suffices for certain materials is wholly insufficient for others. We know that certain steels, which we call "fragile," behave very well under quiescent tests but are very brittle under impact. A factor suitable for them would involve a great waste if applied to infragile steel, while one suited to infragile steel might lead to death and disaster if applied to that which is fragile. Unfortunately, the fragile and infragile cannot be distinguished by our present quiescent tests, though certain causes of fragility can be detected with the microscope. Under these conditions, unhesitatingly preferring waste to disaster, we adopt a factor suited for fragile steels. This, in turn, means that we load the community with the cost of a superfluity of material in that large majority of cases in which we use infragile steel, lest we invite certain disaster by our present neglect to take the simple precautions of using the impact test so as to detect fragility. To secure infragility by regulating the composition of the product and the process of manufacture is far better than nothing; but these precautions, which the buyer can enforce with difficulty, if at all, should in his interest be supplemented by the direct and positive exclusion of fragile material by means of the impact test.

Ductility and Endurance to Shock Not Related

A like overloading occurs through our trying to provide for the shocks incident to these kinetic services by requiring great plastic deformability, which we currently call "ductility," in the shape of permanent elongation and contraction of area under quiescent tests. This provision at first seems wholly irrational, because these services imply no appreciable plastic deformation, so that we demand properties which will never be utilized. Neither guns, nor rails, nor tires deform plastically in use to any appreciable extent. The excuse is that to increase the ductility, even that determined quiescently, is to increase the power to endure shock. Unfortunately, the shock resistance thus implied is far less in fragile steels than in infragile ones, so that in order to secure enough of it for the fragile steels which we may use unwittingly we specify a degree of ductility wholly superfluous in infragile ones. This superfluous ductility is very costly, whether it is got without sacrifice of strength by means of special heat treatment or composition, or, sacrificing unit strength, by using much more of a much weaker steel following the principle that for given grade of steel every gain of ductility carries with it a corresponding loss of strength. We could save this needless expense by using the impact test and thus detecting fragility, for then we could lessen the ductility which we exact to that needed for infragile steels.

It is beside the mark that for many uses, including some kinetic ones, more material is needed for rigidity than for strength, and that here the teachings of the impact test would not lead to economy. That cast iron is strong enough for sash weights, flywheels, and bed-plates does not prevent our heat-treating alloy steels for aeroplanes.

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*Read before the engineering section of the Association for the Advancement of Science, December 28, 1917.

Fatigue Strengh

Turning to our second subject, my assertion that we do not determine the true resistance of our material, even to relatively quiescent stress, refers to fatigue strength, the resistance to stresses applied repeatedly. Of the four properties which we habitually determine the elongation and reduction of area certainly throw little light on fatigue strength, nor can we expect much from the tensile strength, which represents the exaltation of the elastic limit induced by the plastic deformation after the initial elastic limit has been passed. This deformation cannot be tolerated in hypo-elastic services—that is, in those which demand that each member must retain its initial size and shape; and here the ability of the material to undergo the resultant exaltation of its elastic strength is useless, save as forming a basis for calculating the ductility from an additional point of view, through the elastic ratio, and thus supplementing the elongation and reduction of area as suggestions of impact resistance. How is it, then, with the fourth of these properties which we determine—the elastic limit?

Before answering this it is well to refresh our conception that, because the innumerable ferrite and cementite grains of our steel lie with their slip planes inclined in every possible direction, and because the stresses are not distributed exactly evenly throughout the member or test piece there is some one slip plane in some one grain that is less favorably disposed than any of the others towards the existing stress. That is the weakest spot in the bar. If we increase the stress gradually slip occurs along that slip plane before anywhere else. The failure of this metal to bear its load tends to overload its neighbors.* The stress which causes slip along this weakest plane is, strictly speaking, the true elastic limit, because this slip changes the dimensions of the bar permanently. Perfect elasticity, the power to return exactly to the initial dimensions, exists only below this limit of stress, which hence, by definition, is the elastic limit. That this first slip cannot now be recognized, and probably never can be, and hence that the true elastic limit cannot be determined, affects this inference as little as our inability to see atoms and molecules interferes with our belief in their existence.

The elastic limit which we determine with our extensometers may, for clearness, be distinguished from the true elastic limit by calling it the "observed elastic limit." That it must needs recede as our extensometers become more sensitive and must thus approach the true elastic limit asymptotically is clear.

True Elastic Limit is Fatigue Strength

If this stress which has caused the first incipient slip is released the elasticity of the rest of the metal reverses the slip, and if the stress is quickly re-applied new slip recurs along this same plane, and so on with quickly succeeding applications of stress, according to our conception, which, moreover, holds that this repeated slipping back and forth causes local degeneration. Moreover, the overloading of the adjoining parts by the slip along this one slipping plane leads them in time to begin slipping, so that after many repetitions of the cycle this degeneration extends through so much of the section that the remaining sound metal is unable to sustain the stress, and hence breaks. This leads naturally to the conception that the true elastic limit is the fatigue strength.

Without insisting on the accuracy of this picture, it certainly helps us to understand why our present observed elastic limit does not measure the fatigue strength, and stimulates us to determine much earlier stages of slip, in the hope that as we approximate the true elastic limit we shall thereby approximate the fatigue strength as well.

Two methods which might lead to much closer approximations than can be expected from refining our direct measurement of the changes of dimension by means of extensometers are the thermal and the magnetic.

In the thermal method the fatigue strength is determined as the stress of which rapid repetitions cause a detectable rise of temperature, supposed to represent the heat evolved by the friction along the first slipping planes. This method owes its attractiveness to our conception that the thermo-electric measurements of temperature seem intrinsically capable of greater sensitiveness than the direct measurement of length. On further examination the method loses some of its promise, for though a slip over a very minute area might yield enough heat to be detected if it lay at the very outside of the specimen, if it were deep-seated it might not, because the heat in working outwards would spread itself over a very large area of surface, and this would lessen correspondingly the actual rise of temperature. Hence, if we took the stress which causes the first detectable rise of temperature as our best approximation to the fatigue strength, our results might vary greatly with the position of the first slipping area.

The Magnetic Method

The magnetic method would determine the fatigue strength as the least stress of which repeated applications cause a detectable change in the magnetic properties. The developments of this method which are now occurring at the Bureau of Standard deserve our most careful attention.

From the fact that the ability to endure many millions of repetitions of stress is much less than the observed elastic limit, and from our natural explanation that the difference represents some form of progressive degeneration under indefinitely repeated stresses, we naturally infer that when the repetitions are in the hundreds of thousands, a like but smaller degree of this same degeneration occurs. From this, in turn, we infer that even when the repetitions are only in the thousands this degeneration may occur, though in correspondingly smaller amount. From this we generalize that the gap between the observed elastic limit and the safe working load should increase as some function of the number of repetitions of stress to be expected during the life of the member, and we ask whether this increment should not be considered even in designing bridges, and whether it should not increase with their expected life and the frequency of the passage of trains.

A natural question which arises in this connection is whether, as regards fatigue strength, that part of the elastic limit of steel which is caused by a low finishing temperature in rolling is valid or fictitious and removed during the exposure to repeated stresses. The great life of piano wires, strained very severely and exposed to a repetition of stress with each sound wave, and of suspension bridge wires, both of which owe much of their elastic strength to cold deformation in the shape of wire-drawing, is reassuring. An interesting case is that of piano wire, which is credibly reported to have sprung back into a helix when cut after fifty-four years' service, showing that it retains, even through its enormous number of repetitions of stress, the bending given it in coiling it.

Letters to the Editor

Steel Shingles for Houses

Editor, Contract Record:

I read with interest an article contributed by Leslie H. Allen, entitled "Problems in Industrial Housing," and was particularly interested in that portion relative to roofs on moderately priced industrial homes.

Mr. Allen's experience may be widespread, but I am under the impression that his sphere of operation is practically confined to the Atlantic coast. I am convinced that during the past ten years more residences have been covered with galvanized iron shingles than with all other combined materials, with the exception of wooden shingles.

Any of the firms engaged in the manufacture of galvanized steel shingles for the last 25 years or more, can point to thousands of roofs in the towns, villages and rural municipalities of Canada that are today in splendid condition and apparently good for another half century. Until the war these shingles were sold at a very moderate price, and being absolutely fireproof and of quiet design, became very popular. It was the galvanized steel shingle that replaced the cedar shingle in Canada.

Steel also replaced wood lath in a great many of the houses erected in Canada during the past ten years, foresighted contractors and owners using metal lath throughout if they could afford it, but invariably in the ceiling, where permanency of the plaster was desirable. This program is recommended to any contractor or owner who wishes to keep down maintenance charges, and be assured of the stability of the workmanship.

Yours truly,

W. E. Ramsay,
The Pedlar People Limited,
Montreal, Que.

Reply to Barber Asphalt Paving Co.

Editor, Contract Record:

On page 1032 of your December 19th, 1917, issue of the Contract Record, we note a letter signed by Mr. Daniel T. Pierce, Executive Assistant of the Barber Asphalt Paving Company, in which he comments upon a former communication signed by us that appeared in your number of November 28th.

Mr. Pierce' letter does not seem to get much further along the road towards an understanding of why we should differentiate asphalts to be used for paving purposes into those derived from native asphalts and those derived from oil asphalts. Admitting that "specifications of the blanket type are always unsatisfactory at the best," which Mr. Pierce quotes from our former letter, such statement does not, of itself, prove that anything more satisfactory can at present be devised. Certainly we do not want to adopt any other type of specifications until we definitely know the reasons for doing so, and that such reasons are both sufficient and legitimate.

Any line of demarcation that cannot be followed down to its effect upon the square yard or other unit of finished asphalt pavement does not seem to be of much interest to the travelling—and paying—public, for whose use and protection standard specifications are prepared. We have yet to learn of such a distinction between the pavements produced by cementing their mineral aggregate with asphalt cement manufactured "(a) By fluxing refined solid-native asphalt with petroleum residuum . . . ," and those produced by cementing their mineral aggregates with asphalt cement manufactured, "(b) By the distillation or refining of crude liquid mineral bitumen. . . . ." The quotations above are from the alternate or differentiating specifications suggested by Mr. C. N. Forrest, and contain all there is, of any importance to us for the present purpose, in the said specifications. The remainder of what follows the "A" and the "B" alternates is practically parallel, for the slight distinctions made are of no importance, and could easily be covered in single "blanket" paragraphs.

Again we ask, as in our former letter, "why differentiate along the lines of native and oil asphalts?" What are the reasons, which Mr. Pierce says are so "obvious," that should cause us to do as the Barber Company wishes? Such reasons may exist, but we do not know them. Mr. Pierce has not advised us, nor has Mr. Forrest; but possibly, as manager of the technical department, Mr. Forrest has something in preparation.

At present, we might admit that the only reason we know for adopting the alternate specification suggested by Mr. Forrest is that we believe our good friends, the Barber Asphalt Paving Company, would then have a complete commercial monopoly of the "solid-native" crude asphalts required to manufacture the necessary asphalt cement in accordance with the alternate "A" formula, which monopoly they could no doubt use in their business. This reason does not seem to us quite sufficient when examined from the viewpoint of a member of the American Society of Municipal Improvements.

Yours truly,

Milton Hersey Company, Ltd.,
C. A. Mullen,
Director of Paving Department.

The Dominion Textile Co. to Start Building

F. G. Daniels, general manager of the Dominion Textile Company, Ltd., announced that work on the new St. Lambert, Que., plant will be started during the coming summer. The destruction of the Halifax mill has made it necessary to hasten the South Shore plans, and, while the operations during the coming summer will not be on an extensive scale, it is proposed to erect a weave shed and the preparatory buildings in the very near future. The new plant is to be built of reinforced steel and concrete, and will cost something like $3,000,000. It has not been decided as yet whether the Halifax mill will be rebuilt.

$50,000,000 Petroleum Refining Concern

The incorporation of "Imperial Oil, Limited," with a capital of $50,000,000, and headquarters in Montreal, is announced, to take over the business of refining and marketing petroleum in its various forms as now carried on in Canada and Newfoundland by the Imperial Oil Company, Limited.

Mainly Constructional

East and West—From Coast to Coast

A contract for clearing a large section of the devastated area in Halifax has been let by the reconstruction committee to Cavicchi & Pegano.

By a unanimous vote the Council of Dufferin County, Ont., at its December session, adopted a good roads scheme, under the Ontario Highways Act.

Two bridges on the C.N.R. in British Columbia were carried away during the recent floods—one at Yale and another at Mile 38, near Mt. Lehman.

Brantford's building permits for 1917 show an increase in value over the previous year of $144,000. There were 303 permits in all isued, the value being $287,195.

Building permits issued in Welland, Ont., in the month of December are valued at $1,000, as against $11,225 the same month last year. The 1917 total is ahead of the 1916 total, the figures being respectively $241,334 and $202,587.

There were 105 building permits issued in Galt, Ont., in 1917, at a value of $186,430, while in 1916 the total was 145 permits, valued at $253,795. The number of new buildings erected in 1917 was 30. There were only two factory additions.

Commissioner of Works Harris, of Toronto, has stated definitely that the city will, as soon as the weather moderates sufficiently in the spring, proceed immediately with that portion of the work on the Bloor Street Viaduct which still remains to be completed.

London, Ont., building permits for the month of December number 26, and are valued at $34,590, as compared with 31, valued at $18,705, in the same month last year. The total for the year 1917 is 843 permits, at a value of $837,890, compared with 1,034, valued at $926,125, for 1916.

Governmental approval has been received for a new waterworks system to serve the town of Ojibway, where the Canadian Steel Corporation is engaged in the construction of its huge steel plant. The supply is to be drawn from the Detroit River, in which a 250-foot intake pipe is to be laid.

A new bridge is being built by the municipalities of North and West Vancouver over the Capilano River at Keith Road. Recent freshets changed the course of the stream to such an extent that the main pier was in the centre of the water course, and the engineer recommended that a little dredging be done to divert it into its former channel.

The Algoma Steel Corporation has started construction work on twenty-five new by-product coke ovens for the manufacture of tar, coke, ammonia, benzole, totuol, etc. The new ovens will be auxiliary to those now in operation, and will incerase the output 30 per cent. More orders for munitions are to be taken when the work is completed next midsummer.

The Montreal building season of 1917 is over, and the total value of the permits is available. The figures are $4,387,638, a decrease of $946,546. Of the total, $3,252,757 was for new buildings and $1,134,881 for repairs. The permits are the lowest since 1904, and in comparison with the boom year, 1913, show a very marked decline, that year having a total of $27,037,297.

Work is starting on the foundations for the main buildings of the shipbuilding plant for the Dominion Shipbuilding Company, at the foot of Spadina Avenue, Toronto. The construction will be carried out by the staff of the Toronto Harbor Commissioners, under the supervision of Assistant Chief Engineer J. G. R. Wainwright. The foundations will be of pile and concrete construction.

To meet the demands of their rapidly increasing business, the John Bertram & Sons Company have found it necessary to extend their plant at Dundas, Ont., and have let the contract for a new wing, to cost about $150,000, to P. H. Secord & Sons, of Brantford. The new building will be of brick and steel, and will be on the site of the old pattern and woodworking shop, which has been moved. In dimensions it will be approximately 70 ft. x 300 ft. The contract calls for its completion in six weeks.

Three new pavilions of fifty beds each are to be erected at once at Kentville, N.S., Sanatorium, by the Military Hospitals Commission for the accommodation of returned soldiers suffering from tuberculosis. Two pavilions of thirty-two beds each have already been erected and occupied and a sixty-bed infirmary for advanced cases will be ready for occupation shortly. It is planned that four more of the fifty-bed sanatoriums will be erected later on as required until the Kentville Sanatorium becomes a five hundred-bed institution.

A rather difficult and unusual piece of work has been carried out by Messrs. Green & Woolrich at the factory of William Kennedy & Sons, Ltd., on Eleventh Street West, Owen Sound, Ont. In order to provide for the extension of the electric crane from the steel plant through to the machine shop it was necessary to remove all interior supports for the roof, as well as raise the roof of the machine shop. This involved the jacking up of the roof to the required position and the building of trusses about six feet high on the stone sidewalls.

Personals

Mr. George N. Hatfield, road engineer of St. John, N.B., has been temporarily appointed city engineer to fill the vacancy caused by the death of the late Mr. William Murdoch.

Major E. F. Lynn, who has already won the Military Cross, has received additional honors, now being decorated with the Distinguished Service Order. Major Lynn, who is a civil engineer, left for Valcartier as a lieutenant in August, 1914. While attached to the Second Field Company, Canadian Engineers, he distinguished himself by his skill and bravery in carrying out many difficult operations.

Lieutenants-Colonels Frederic Clarke, James Cornwall, Athol Griffin, Chilion Hervey, James Macdonald, Lawrence T. Martin, Walter Moodie, Kenneth Ramsay, and Blair Ripley, all of the Railway Construction Corps, have been awarded the D.S.O. Lieut.-Col. Ramsay raised the first railway construction battalion in Canada, and, prior to that, was for several years with the C.P.R. as construction engineer.

Obituary

Mr. R. Mackay Fripp, the well-known architect, passed away recently at his home in Vancouver.

Mr. Charles Unwin, a well-known resident of Toronto, died recently at his home in that city, at the age of 88 years. Mr. Unwin was a Dominion and Ontario land surveyor, and was at one time secretary of the Provincial Board of Examiners. He was city assessor for some thirty-two years, and was city surveyor from 1905 to 1910. Born in Mansfield, England, in 1829, he came to Canada in 1843 and attended Upper Canada College until 1847. In 1852 he received his diploma as provincial land surveyor. He carried out a number of important commissions for the government, among which may be mentioned the surveying of the Indian reserves on the north shore of Lake Huron.

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Fair Outlook for Building Trade

WHILE complete returns of the building permits in Canada during the past year are not yet available, the aggregate of the building permits issued for the first eleven months of 1917 is lower by over five per cent. than the corresponding value of 1916. If the building permits are to be taken as a gauge of the volume of construction, the situation in the building and contracting fields, as indicated by the comparison above stated, has failed to improve during the past year. The conditions this year will be hard to predict but a set-back has, within the last week or so, been forecast in a statement by Hon. F. B. Carvell, Minister of Public Works, that all expenditures outside of maintenance are to cease on the public works of Canada, the Halifax reconstruction alone excepted.

To many, this situation appears to be critical and anything but optimistic. Many intimately connected with the engineering and contracting fields see in the low ebb to which building in general has sunk, a condition well nigh hopeless. No doubt individual contractors are suffering by the scarcity of work, but a general survey seems to indicate that pessimism should be far from the rule.

While prices of labor and material were never so high, we believe that it is not first cost that is deterring owners from building. The purchasing public in general is in a stronger position than it has been for years. This fact, with the industrial activity imposed by the demand for war supplies, would ordinarily indicate considerable activity on the part of private interests. After three and a half years of war, however, there is a certain frame of mind that is so acting as to confine purchases to necessities. It is this tendency, and not the fear of first cost, we think, that is operating to keep construction at a low ebb. Speculation, ordinarily resulting in superfluous building has been practically killed, and in reality only urgent structures, or those directly contributing to the waging of the war, are contemplated.

While this tendency has doubtless added to the troubles of the contractor, there is still room for optimism. The restraint on construction has prevented expansion to such a degree that the country is under rather than over-built. When war comes to an end, therefore, the contractor will be in an excellent position. It will be necessary to make up the deficit in our requirements and there is every promise that contractors will find plenty to do in constructing those projects that have been held over.

In the meantime, however, there is a little work being picked up here and there. Increasing rents will have a tendency to drive people to build their own houses. Of course, the centre of activity for some time to come will be Halifax. Here the alternative is presented of handing the contract for rebuilding to one or two big firms or distributing it among a number of smaller contractors. In view of the nature of the work to be performed the latter would seem to be the proper course. Would it not be well, then, for our builders' exchanges to get together and see whether some scheme cannot be worked out by which they can help Halifax and at the same time keep their own organizations together?

Fire and Load Tests of Building Columns

FIRE tests of building columns, being jointly conducted by the Associated Factory Mutual Fire Insurance Companies, the National Board of Fire Underwriters, and the Federal Bureau of Standards, at Underwriters' Laboratories, are progressing according to schedule, two columns being tested each week. The work of testing began last summer, and will require a year for the completion of the full series of 100 tests. This was preceded by several years' work in designing and erecting the testing apparatus and in preparing and covering the test specimens by the different methods and with the various materials required for a full investigation. In the Contract Record of August 15, 1917, a brief outline of the test equipment was presented. The paragraphs that follow embody the essential features of the apparatus.

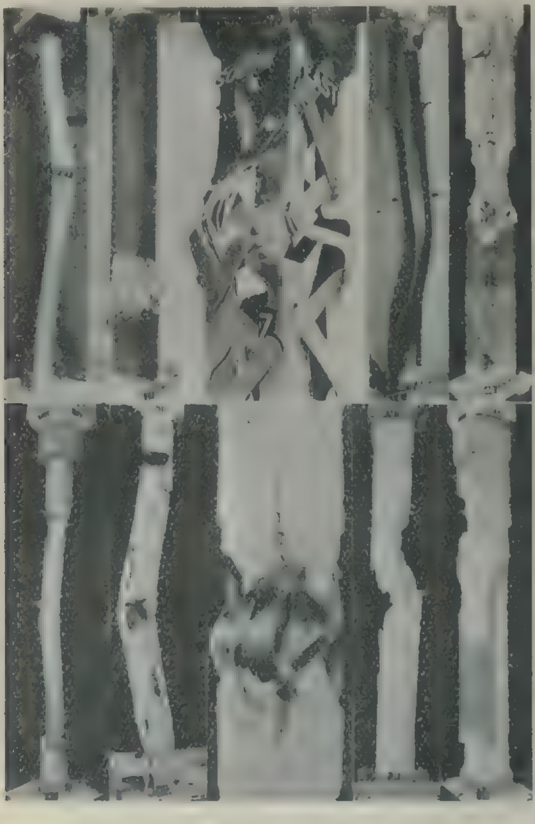
The apparatus used in the tests consists, briefly, of a gas furnace, capable of being controlled according to a specified standard temperature curve, reaching a maximum of 2,300 degrees Fahr. (1,260 degrees Cent.)

at the end of an eight-hour test. The load on the columns, while being subjected to fire test, is supplied by means of a hydraulic ram, an average load of 100,000 pounds being maintained during the test, this being calculated for the various sections according to accepted formulas for working load.

Thermo-Couples Measure Temperature

The temperature of the column furnace is measured by means of platinum and base metal thermo-couples, supported in porcelain tubes at two elevations, and that of the columns by means of base metal thermocouples attached to the metal of the column at four elevations and at different points in the section. The temperature indications are read with a potentiometer indicator and connections are also made to an automatic potentiometer recorder, so that graphic records can be obtained, if desired, of the indications of any set of couples.

The vertical compression and expansion of the columns, due to the load and heat, are measured over a gauge length of 37 inches in the upper half of the column by means of wires attached to the column at each end of the gauge length, the other ends being weighted and passed over an idler at a point outside of the furnace and as far from the column as room conditions will permit. The wires are protected inside and outside of the furnace by suitable insulating and protecting tubes. Readings of vertical movement are taken at intermediate points on the wires by means of miscroscopes mounted in micrometer slides, the true movement at the column being calculated from the distance relations of the microscopes and the fixed end of the wire, with reference to the point of attachment to the column. The lateral deflection of the column is measured by means of readings on scales placed perpendicular to and parallel with the wires.



Effect of load and fire on building columns.

All of the tests are of full-sized columns of 12 ft. 8 in. effective length, and of various steel sections, which are protected by concrete, tile, and other forms of fire-protective coverings. One column of each type is tested unprotected; also several concrete columns reinforced according to methods used in current practice have been introduced.

The tests are continued to a breakdown of the sample, and hence no inferences as to the comparative merits of the various column designs and column coverings should be drawn from the illustrations, which show simply the effect of load and fire on a number of samples which have been subjected to test. The time required to obtain failure varies with the type of material and thickness of covering, the periods for the columns so far tested ranging from seventeen minutes for the unprotected column to over eight hours for the heavier types of protection.

This is the first work of this character ever undertaken employing modern forms of columns and methods of protection, and it is expected that it will develop data of great nterest to city governments, underwriters, manufacturers, architects, and engineers.

Specifications for columns and column coverings have necessarily been made ever since the advent of modern fire-resistive construction, but there has been little or no experimental data as a basis for the various requirements promulgated, which in point of amount of protection required differ by more than 100 per cent. as between various city building codes.

It is also thought that the tests will give much information on the general fire-resistive qualities of the covering materials employed. Differences in point of effectiveness of over 100 per cent. have already been found as between concretes made from different aggregates, some showing up unexpectedly well and others indicating decided unsuitability for use where the fire-resistive feature is a point of importance.

C. S. C. E. Annual Meeting

THE feature of the annual meeting of the Canadian Society of Civil Engineers, on January 21-23, at Montreal, will be the unveiling of the honor roll of the members who have gone overseas. The honor roll, containing over 800 names, is placed in the lobby of the society's building, and is framed in oak panelling, designed by members of the society. The Minister of Militia, General Mewburn, and a representative of the American Society of Civil Engineers have been invited to take part in the ceremony, which will take place on January 22, following the annual address of the retiring president, Lieut.-Col. J. S. Dennis.

With regard to the ordinary business, the most important item will be the discussion of the report of the Committee on Society's Affairs, summarized in our issue of December 26. This includes recommendations for a revision of the by-laws, changes in organization, and a proposal to alter the name to the Engineering Institute of Canada. The report of the Committee on Steel Bridge Specifications will also be presented.

Mr. F. B. Haanel, chief of the division of fuels and fuel testing, Department of Mines, Ottawa, will read a paper on "Fuels," followed, it is expected, by an address by Mr. C. A. McGrath, Fuel Controller, who is a member of the Society. Mr. R. A. Ross and Mr. A. Surveyer, who have given considerable attention to this matter as members of the Advisory Council for Scientific Research, will take part in the discussion.

On the night of January 21 a dinner will be held at the University Club, followed by a smoking concert at the society's rooms.

Fine School Buildings in New Brunswick

Descriptions of Recently Completed Structures, Typical of Modern Class of Schools Being Erected in the Eastern Provinces

Aberdeen School, Moncton, N. B.

THE Aberdeen School building recently erected in Moncton is the largest structure of its kind in the Maritime Provinces. It contains twenty class rooms, an assembly hall seating 1,000, waiting room, armory, shooting gallery, library, playrooms, and girls' and boys' sanitaries.

The building is of concrete and stock brick, with Atlantic terra cotta trimmings, sills, lintels, architraves, cornices and columns. The terra cotta columns of the portico, 4 ft. 6 ins. in diameter, are an exceptionally good piece of work.

The interior finish throughout is of Douglas fir finished with P. & L. Alcolac and two coats of No. 38 peservative varnish, the doors having an additional coat of varnish. All floors are of selected birch, 2¼ ins. wide.

The Aberdeen School at Moncton, N. B., is the largest school building in the Maritime Provinces. (F. Neil Brodie, Architect.)

The class rooms are 26 ft. x 32 ft., with 12 ft. ceiling. They have burlap wainscoting 54 ins. high, and are provided with slate blackboards, teachers' cabinets, bulletin boards and tack boards.

Each floor is supplied with bubbler drinking fountains, and 2½ in. hose reels for fire protection.

The general toilet rooms are in the basement, while two additional toilets are provided on the third floor. All toilet rooms have individual porcelain water closets.

The building is lighted by electricity and has a Holtzer-Cabot fire alarm system with break-glass stations in all halls, assembly room, basement and furnace room.

The heating and ventilating system, designed by F. M. Hoadley, engineer, of Montreal, is direct radiation, and warm air is forced by an electrically-driven fan throughout the building for ventilation. There are two fire-box, smokeless boilers, burning natural gas. In a 30-day test, from January 15 to February 15, with the thermometer below zero for 19 days, the building was very comfortably heated at an average cost of $6.70 per day.

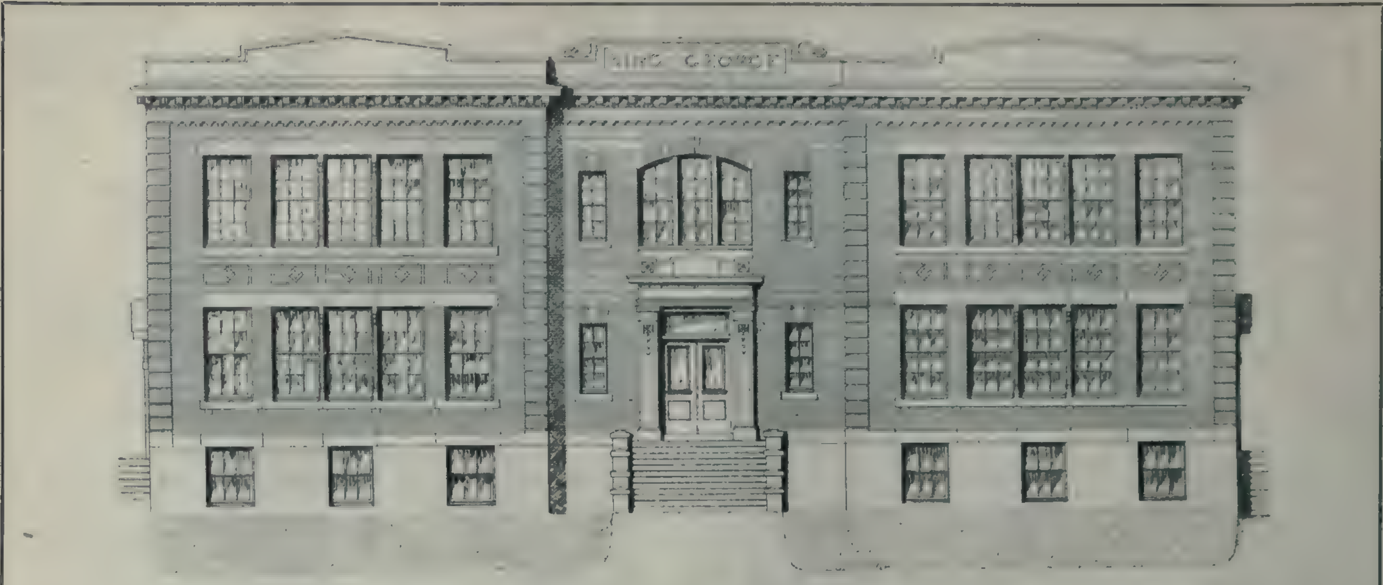
The cost of the building was about $104,000.

The King George School, St. John, N. B.

THIS new building, most modern in its planning and equipment, was occupied for the first time, in the last week of November. It contains nine class rooms, 27 ft. x 32 ft., with ceilings 12 ft. high, and an assembly hall, 37 ft. x 66 ft., with a 15 ft. ceiling. This latter room is situated on the ground floor, is wired for electric lighting and moving pictures, and can be utilized apart from the rest of the building if so desired. The building has a concrete foundation and stock brick walls with Sackville red stone trimmings.

A sloping site necessitated the construction of a retaining wall, at some points, 23 ft. high, and to make this secure against the jarring of passing trains, it was strengthened with reinforced concrete buttresses, placed at a distance of 15 ft. along its entire length.

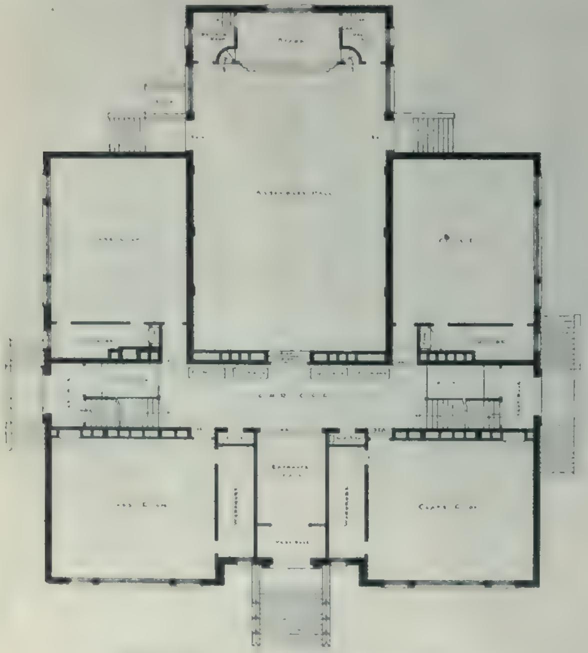
In the basement are the boys' and girls' sanitaries, fitted with J. L. Mott "Colonial" porcelain ranges and urinals; boiler room, cadet room, and play room; all floors being finished with "Lapidolith." Concrete walls are finished with "Cemcoat." The ground floor contains an assembly hall and four class rooms. On



Elevation of King George school. F. Neil Brodie, Architect.

the second floor are five class rooms and teachers' room, with adjoining toilet.

The building is heated throughout by a two-pipe, gravity system, with Dunham traps and valves, air separating tank and receiver, and pump for returning the condensation to boiler. The boiler is a 50 h.p. return tubular, with Spencer damper regulator. The class rooms have wall radiators placed beneath the windows, rooms with a northern exposure having an additional radiator. In the entrance hall are four large foot warmers. Each floor has a cleaning-up closet containing a slop sink with hot and cold water supply run from a small jacket heater in the basement.



Floor plan of the King George school.

All class rooms have burlap wainscoting 54 inches high, slate blackboards and teachers' cabinets, and are wired for electric lighting. The building has a Holtzer-Cabot fire alarm system with break-glass stations in halls, basement and assembly hall, and a complete system of electric bells. The total cost of the building was about $75,000.

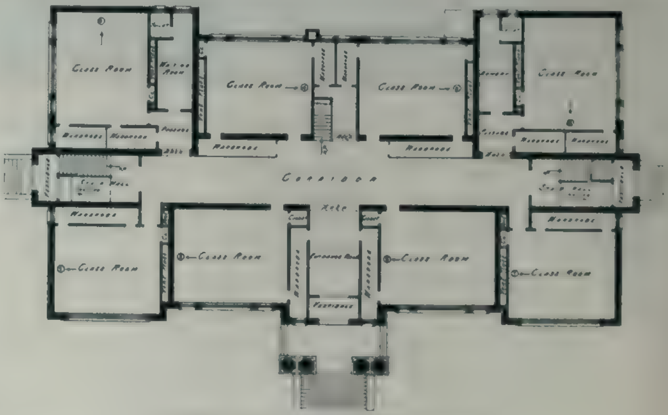
Rothesay Consolidated School

THIS school building was erected about two years ago, in the village of Rothesay, 10 miles from St. John, N.B., at a cost of $29,000. It is built of concrete and stock brick with sandstone trimmings and metal cornice.

The walls of the lavatories, furnace room, coal room and corridors in basement are of brick, the floors throughout the basement being concrete with cement finish. The ceilings of lavatories, furnace and coal rooms and corridors in basement are finished with cement mortar. Walls and other ceilings throughout the building, including those of the domestic science and manual training rooms in the basement, are plastered in three-coat work.

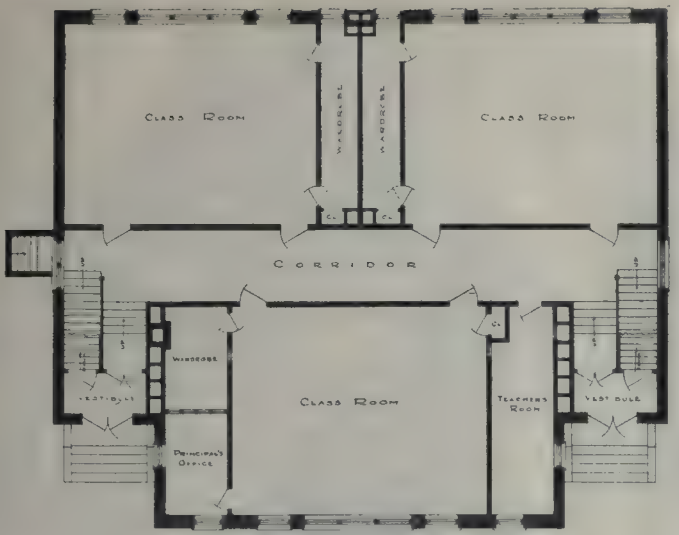
Floors and stairs are of brick. Interior finish throughout is of Douglas fir, and all corridors, class rooms and wardrobes are wainscoted.

The building contains five class rooms, teachers' room, principal's office and assembly hall on ground and second floors. The class rooms are 25 ft. x 32 ft. with a teacher's cabinet. All windows are fitted with the Chamberlain weather strips. The assembly hall, a well-lighted and well-ventilated room, 36 ft. x 49 ft., is situated on the second floor. Drinking fountains are provided on each floor.



Floor plan of the Aberdeen school.

The heating system is two-pipe steam, with wet re-



Floor plan of Rothesay school.

turn, Kewanee boiler, and direct wall radiation. The building is lighted by electricity.

Beaconsfield School, Lancaster

THIS building is similar in plan to the Rothesay School, with a slight difference in the arrangement of assembly hall and class rooms. The latter are 25 ft. x 30 ft. with a 12 ft. ceiling.

The heating is by steam, direct radiation, with wall coils under the windows. Steam is supplied by a Kewanee boiler.

This school was recently opened. The cost of the building is about $33,000.

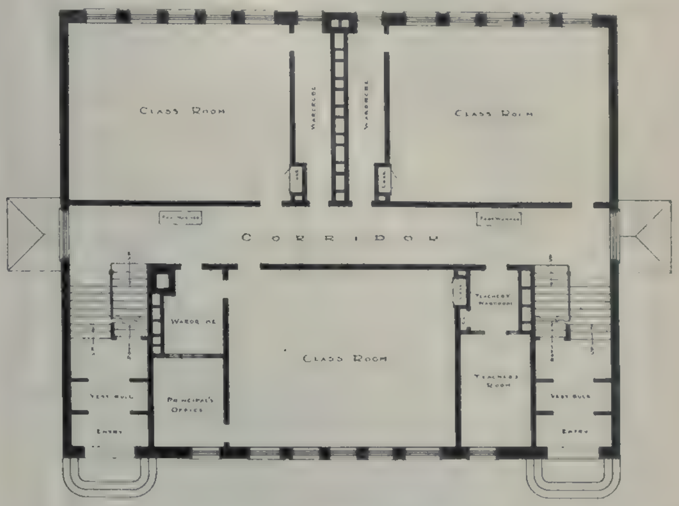
* * *

The designer of all these schools was Mr. F. Neil Brodie, architect, of St. John,

The general contracts and contracts for various trades on these buildings were carried out by the following firms:

Aberdeen School

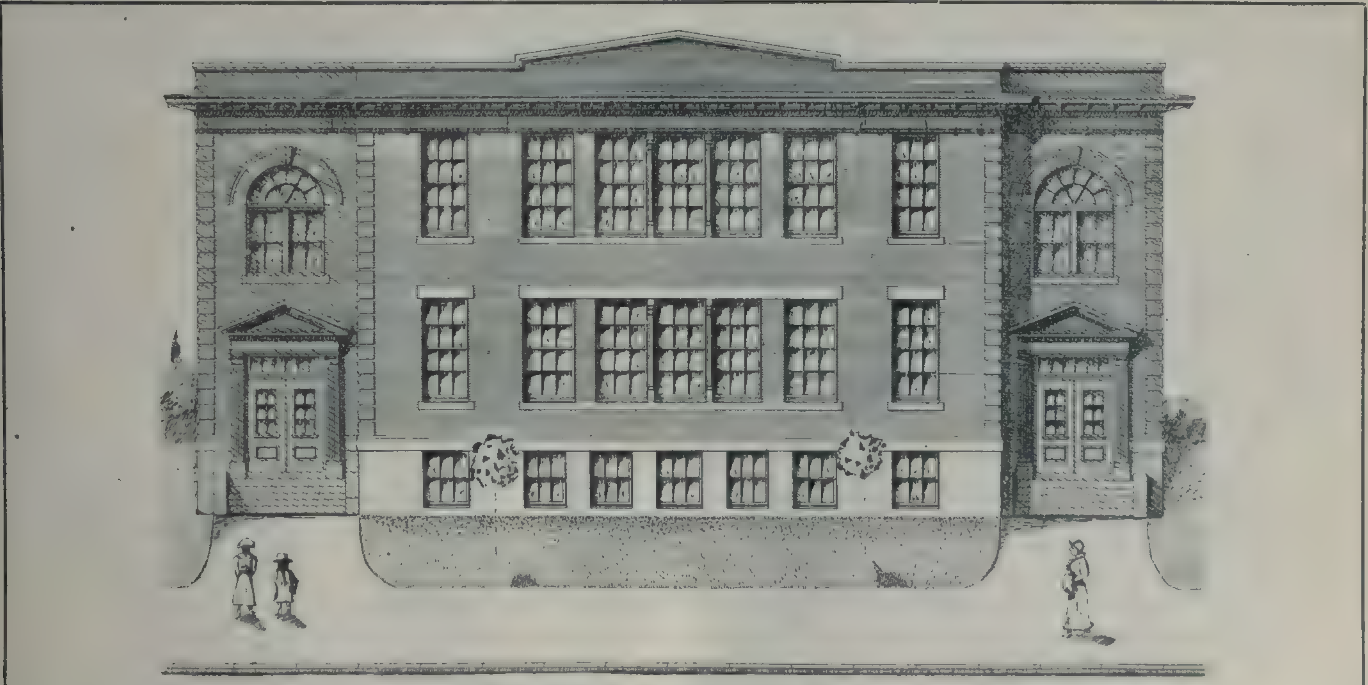
General contract, the Paul Lea Co., of Moncton, N.B.; blackboards, Slatington Blackboard Co.; boilers and radiators, Taylor-Forbes Co.; plumbing, Hagen & Co., Amherst, N.S.; desks and chairs, Canadian Office & School Furniture Co.; plaster, Albert Mfg. Co., Hillsborough, N.B.; plumbing fixtures, Jas. Robertson Co., Ltd.; structural iron, Maritime Bridge Co., Ltd., New Glasgow, N.S.; terra cotta, Atlantic Terra Cotta Co., New York; varnish, Pratt & Lambert, Buffalo, N.Y.; ventilators and fan, B. F. Sturtevant Co., Montreal; heating engineer, F. M. Hoadley, Montreal.



Floor plan of Beaconsfield school.

King George School

General contractor, B. Mooney & Sons; carpentry, Ernest Green; heating and plumbing, G. & E. Blake; painting and glazing, Jas. H. Pullen; sheet metal work, Jas. McDade; roofing, Joseph Cameron; electric wiring, H. Webb & Sons; desks and furniture, S. Lordly.



Elevation of Rothesay Consolidated school. F. Neil Brodie, Architect.

Rothesay Consolidated School

General contract, Joseph Henderson, Rothesay; mason work, Jas. Sproul; sheet metal work, J. E. Wilson, Ltd.; iron work, James Fleming; electric wiring, Hiram Webb & Sons.

Beaconsfield School

Mason work, Grant & Horne; carpentry, J. M. Belyea; sheet metal work, J. E. Wilson, Ltd.; painting and glazing, Wm. E. Demings; electric wiring, Frank E. Jones.

How to Avoid Efflorescence on Face Brick

PROBABLY one of the things most annoying to architects and owners of brick buildings constructed in recent years is the unsightly appearance of efflorescence on the brick every spring, in some cases completely covering the upper storeys.

It has been noticed that this is more pronounced under the copings, sills, belt courses, etc., or wherever a part of the building has been subjected to a greater wash by water. This indicates that the mortar, as well as the brick, is absorbent, causing the walls to become thoroughly soaked during the winter months, while the warm rays of the sun attract the moisture to the exterior, bringing with it the lime, magnesia, and alkali salts contained in both the brick and the cement mortar.

It is agreed by all interested in brick construction that both brick and cement mortar are absorbent, yet little has been done to overcome this objectionable, serious, and dangerous obstacle. Hydrated lime will add to the plasticity of the mortar, increase the density, and, being a water retainer, will add crystallization when used in places where it is difficult to apply water at frequent intervals. Tests have repeatedly shown that slabs containing 10 per cent. hydrated lime, when taken out of the water, after one hour will contain a larger percentage of water than a similar sample of cement and sand, yet on the surface the lime sample is apparently bone dry.

The best-known solution of the above problem, which has withstood a test of over two years, having been adopted in the construction of a prominent Eastern college, is impervious cement mortar to consist of:

One part approved portland cement.

Three parts sharp, clean sand, showing not over 35 per cent. voids by water.

Ten per cent. of weight of the cement of hydrated lime (sufficient to add to the plasticity of the mortar and retain enough water to perfect crystallization).

Two per cent. of weight of the cement, Medusa paste waterproofing. Each gallon (eight pounds) to be mixed with equal parts of water, later adding twenty more gallons. All mortar to be gauged with this solution.

If the sand is damp, a one to fifteen solution should be used to offset the moisture already in the sand.

All exterior brick and stone work to the depth of 12 inches should be embedded in this mortar.

The extra cost of waterproofing the cement mortar will not exceed $1 per M. bricks.

Terrace Cottage Type of Houses for Halifax

Temporary Housing Being Rapidly Provided Buildings of Eight Apartments Each with Modern Conveniences at Low Rental

THE cut reproduced herewith shows the type of house which is being provided by the Reconstruction Committee at Halifax for the refugees in that city. As will be noted, each separate building contains eight apartments—four upstairs and four downstairs. The four upstairs apartments are approached from the street by two entrances, one stairway leading to each pair. Every house has a bath room, supplied with hot and cold water, and the kitchen is provided with a range and hot water tank.

The reconstruction committee are erecting 320 of these houses on the Exhibition race track. There will be forty buildings, each containing eight apartments, the whole accommodating 320 families or from 1,920 to 2,240 persons.

The buildings are calculated to last for five years without renewal of material. The construction is substantial and the roof and exterior walls are covered with roofing paper, insulating material being laid between the floors and behind the interior sheathing.

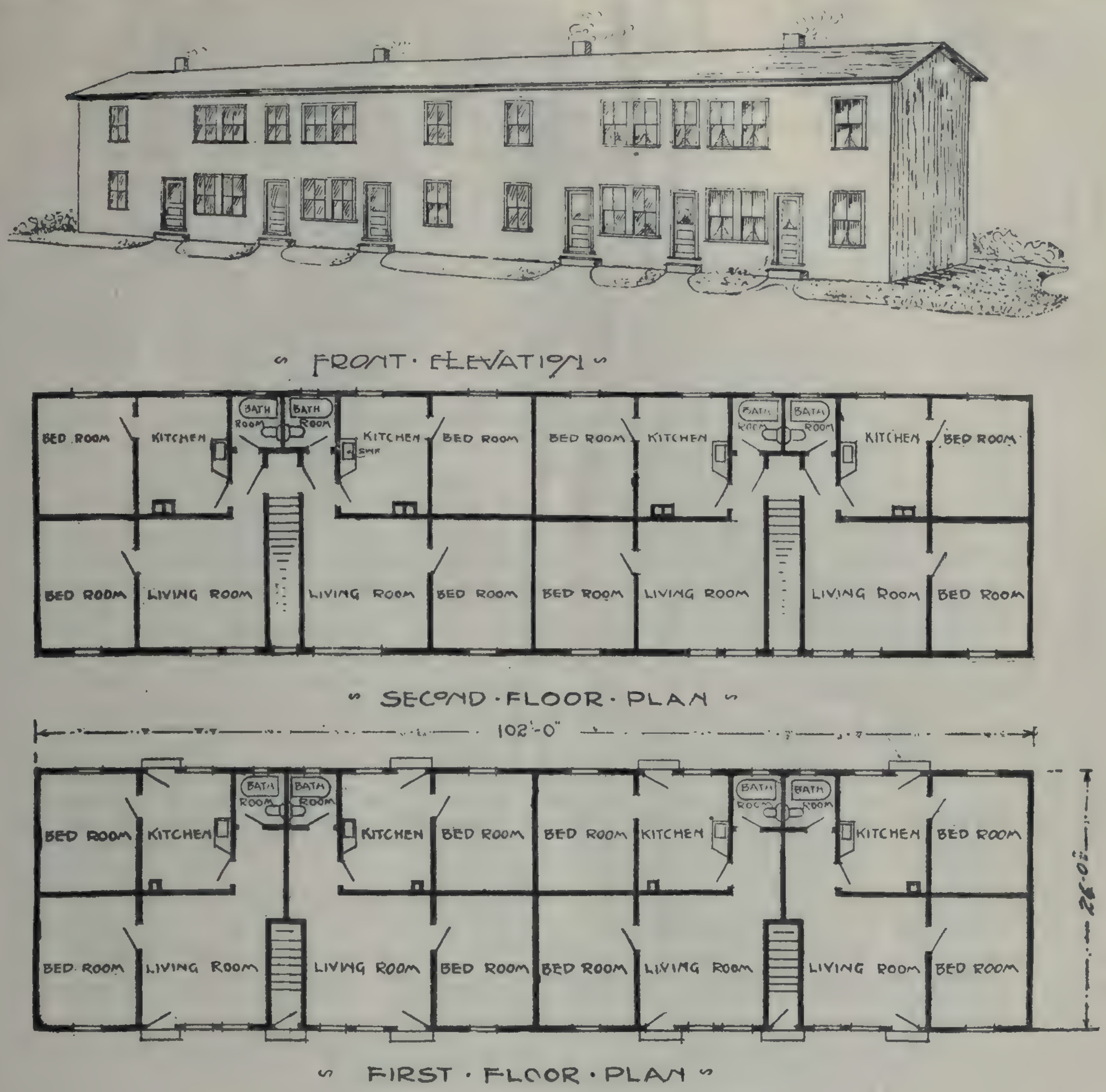
The houses are being erected in six rows facing east and west on streets forty feet wide, the water and drain pipes leading from mains laid in the rear of the houses. Fire protection is given by hydrants fed from water mains, and the plumbing is installed in accordance with standard regulations.

Work on these buildings was started on December 21, but bad weather and slow delivery of materials held operations up considerably. At the time of writing, however (January 7), the greatest delay was over and material was coming at the rate of about three carloads per day. Another difficulty was the securing of sufficient labor, but over 400 men had been obtained and very rapid progress was expected. Seven of the buildings, which were directly undertaken by the Reconstruction Committee, had been boarded up and roofed in, and of these five were completed outside except for the door and windows. One apartment was ready for occupation.

While the Committee has the lead in the matter of rapidity of work, contractors who have undertaken the construction of temporary houses, are making good headway. Bate, McMahon and Company have started work on the erection of ten buildings, with 160 apartments, 120 of three rooms and 40 of two rooms. These are built on the Military Apartment Houses design and will be excellent salvage as they can be used by the military for barracks after their need as emergency shelter is passed. These apartments have hot and cold water in each room from a central boiler. The total capacity is from 400 to 600 persons. The rent is $7.50 per month for a three room apartment and $5.00 for a two room apartment.

Other Types

Then on the South Common fronting on North Park Street there are what are known as the Silliker



Type of eight-apartment temporary dwelling for Halifax.

Units; the Eastern Investment Company, contractors. These are built on a smaller type of the Reconstruction Committee design at the Exhibition race track. There will be twenty buildings here, with 160 apartments or houses, each house having four rooms and bathroom, and range, boiler, bath, closet and sink, with hot and cold water. The total capacity is from 800 to 960 persons. The rent is $10 per month.

On the South Common, fronting on the Bell Road are being built twenty-four houses, Falconer and Macdonald being contractors. These are of the same design as those on the Exhibition race track. Here there will be 192 apartments, with a total capacity of 1,152 to 1,344 persons. The rent here is $12 per month.

The total capacity of all these houses is 5,336 persons. They are furnished as comfortably as conditions permit and the only qualification for tenancy is that applicants had their homes rendered uninhabitable by the explosion.

Montreals' Filtration Plant Soon Ready

The new filtration plant of the city of Montreal will be ready for operation at the end of February. The capacity is 50,000,000 gallons per day, and as the high point of water consumption has already exceeded this amount, Controller Cote announces that a supplementary plant will have to be constructed. This plant was described in the Contract Record of January 26, 1916.

Toronto Electrical Engineers

The Toronto Section of the American Institute of Electrical Engineers, at its meeting on January 18, will have a paper by Maurice J. McHenry, of the Canadian General Electric Company, on the subject of "Commercial Applications of Synchronous Motors."

The Toronto Section is co-operating with the Cleveland Section in holding a meeting at Cleveland on March 8.

Proper Formulation of a Building Code

Something More Than Writing Ordinances or Drawing Up Specifications — Suggested Classification — Fire Regulations

"BUILDING a building code is something more than writing ordinances or drawing up specifications. It is the laying of the foundation for building a city full of structures. It is the setting of a city's standards of safety and security. It is an index of the intelligence of its people, and may well be said to be a measure of their comfort, happiness, and prosperity. These things may be said of a building code when it covers all the phases of the subject."

This paragraph from a paper read by J. A. Ferguson, secretary-engineer of the Building Code Committee of the city of Pittsburg, before the American Association for the Advancement of Science, expresses the necessity of more widespread study in the formation of building codes. A review of his paper follows:

A properly planned building law will cover practically every phase of the occupancy and construction of all the structures within its limits, and may even be found properly to have the right to regulate the location of the various types of buildings.

While taking into account the rights and freedom of those most immediately affected by its positions, the necessity for safety regulations as well as safe construction, the rights of its citizens to protection from nuisance, and annoyance of disagreeable encroachment upon their privacy and property rights, the scope of a real building code should conform to the following definition:

To provide regulations for and control over the occupancy, construction, and location of buildings so as to safeguard the city and its inhabitants against disease and the spread of disease, immoral conditions, loss of life, limb, and property from unsafe and improper construction, and from fire and the spread of fire and any other danger or hazard thereto.

The fundamental principle upon which all good law should be based should be safety of the individual in the exercise of his rights. In order to assure proper working of the building law the principle objective should be a clear statement of limitations of rights. However, when it is necessary, a clear statement, not of limitations of rights, but of a person's rights under the code to do certain things not prohibited by the code, will operate to prevent injustices from improper or overzealous interpretation on the part of the administrative force.

The legal principles involved, then, are based upon questions of public and private safety, and the safety points involved are life, limb, health, and property. All legal rights cease when these have been safeguarded. Each has its ramifications and each its limits, for the right of the builder and owner to individual freedom must be clearly recognized and conserved as long as it does not infringe upon the rights of others. This last must be clearly kept in mind. Too often building laws are one-sided and unjust, due to a mistaken conception of legal rights, for it must be remembered that in endeavoring to prevent encroachment upon the rights of individuals the rights of others may be curtailed beyond the point of fairness.

As a building law is a legal document all the way through, strict adherence to the principles of law are necessary. However, if each case is tested out upon its merits under the statement of principles no injustice will be done. It will become necessary to never fail in the slightest instance to apply the principles.

Systematic Outline

Building laws of the past have not been planned with systematic management of the matter in view. In fact, it would seem as if, in the majority of cases, the various provisions had been jotted down and left in the document in just the casual sequence of their occurrence to one whose mind was not framed to arrange and classify the available information. This very common defect renders much uncertainty to the use of the document. Regulations on a specific subject are hard to locate and are, more often than not, conflicting in their nature. Bibliographies of a subject have often resulted in finding many conflicting provisions, and also have shown that the provisions, when brought together, were absurd and unenforceable, while if separated their absurdity was not apparent.

Thus it will be seen that a building code is in as much need of systematic planning and arrangement as any other business or scientific work. So much of the building code concerns itself with scientific matter and engineering of materials that the systematic outline of such portions of it is indispensable if the code is to be correct in detail and readily usable.

Outline of Typical Building Law

The proper outline for a typical building law will follow the outline given below:

(A)—Administrative Sections: (a) Organization of administrative force; (b) statement of general legal powers and duties of administrative force and outline of methods of interpretation and enforcement.

(B)—General Building Regulations: (a) Enforcement and legal instructions; (b) definitions of words and terms; (c) classifications of buildings in groups according to types of occupancy with respect to danger or menace to life, limb, or property; (d) grading of types of construction into groups according to the resistance to hazards afforded by the materials and their arrangement; (e) requirements for minimum allowable construction, grades for each class of occupancy, based upon the hazard of each; (f) safety regulations containing requirements for exits in the form of doors, stairways, fire escapes, and other means of exit; (g) safety regulations containing requirements for fire preventive and fire fighting apparatus; (h) general regulations for measures to prevent the spread of fire.

(C)—General Engineering Regulations: (a) Plan for interpretation and enforcement of the various sections; (b) definitions of the various words and plans; (c) floor loads for each kind of building occupancy; (d) regulations for quality of materials to provide strength requirements (this should be in the form of requirements for performance and results to be accomplished, and not specifications or prescribed methods or processes for obtaining results); (e) regulations for quality of materials as required for fire resistance (this regulation should be in the nature of a standard for performance accomplished by fire test specification, and be administered as above for strength, and consist of a set of physical test standards for each of the necessary grades).

(D)—Special Engineering Regulations: (a) Special ordinance regulating steel construction; (b) special ordinance regulating reinforced concrete construction; (c) special regulations for various building materials and forms of building construction which must be regulated in detail.

(E)—Special Building Regulations: (a) Regulations for classifications of buildings which are peculiarly hazardous, such as the congested factory, store, theatre, and assembly buildings of various kinds, and buildings in which the fire hazard is heavy or easily set off, as well as those in which are materials which are explosive or become so upon being mixed; (b) special regulations covering safety of handling of explosive or highly inflammable materials; (c) special regulations covering safety requirements during erection and demolition of buildings.

(F)—Regulation for Fire Zones: (a) Descriptions of areas of fire zones. I. High value district, containing highly valued buildings, closely crowded together. II. Moderate value district, containing buildings of moderate value, spread farther apart relatively. III. Low value district—Residence districts and all remaining area within the city limits not included within I. and II. (b) Regulations for minimum allowable fire resistive construction which should be permitted in each of the above districts.

(G)—Fire Prevention and Preventive Apparatus.

(H)—Fire Fighting Regulations and Apparatus.

(I)—Plumbing Regulations.

(J)—Electric Wiring Regulations.

(K)—Health Regulations.

(L)—Elevator Regulations.

(M)—Regulations for Zones for Business, Manufacturing, Mercantile, Residence, and Other Building Occupancies.

These regulations should take into account the inconvenience to persons and loss of property values occasioned by those who build or occupy buildings in an especially obnoxious and dissimilar manner from all other buildings in the neighborhood and zone, regulate and guard zones against encroachments, for each of the principle classes of buildings.

(N)—Creations of Appeals Board: (a) Creating board and describing personnel; (b) describing powers and duties of board; (c) providing rules and regulations under which board must act and work; (d) regulate the work of the board of standards in such a manner that they will approve or disapprove of materials and forms of construction under the standards provided in the building law, and the board of appeals hear and decide appeals from the administrative officers when they feel they have been wronged by the decision of administrative officers.

Classification of Buildings

It is the purpose of this paper to deal in detail with only those portions of the building law which are generally thought of as having a scientific application.

Referring to the classification of buildings, the following classification of buildings according to equivalent hazard of life and limb has been arranged in two groups:

I. Those buildings in which the danger or hazard from fire is high and very much alike and in which the dangers from the number of occupants or the chances they have to escape are not high.

II. Those buildings in which the dangers from the number of occupants are relatively much higher than those arising from the fire hazard and in which the occupancy hazard is high while the fire hazard is apt to be low.

Thus the above two main divisions work into each other's hands, and by so doing simplify the situation by reducing the physical difficulty of providing proper means of safety. This is accomplished because it is not necessary to provide concurrently the following, except in a very few cases where by the nature of the occupancy it cannot be helped, for as a rule high fire hazard usually occurs in buildings with relative low number of occupants:

I. Exit facilities to empty the building of its occupants quickly and safely.

II. Fire protection to fit the inflammability of the contents of the building and prevent loss of life and property by fire and the spread of fire.

General Plan of Classification

Following is the general plan for classification of buildings worked out to fit conditions I. and II.:

Class 1—Buildings of a public character: All buildings designed or occupied in whole or in part for the use of the general public, either for the purpose of state or public assemblage.

Class 2—Buildings for the purpose of public education and culture: All buildings designed or occupied in whole or in part for the purpose of education, art, or culture.

Class 3—Buildings for the purpose of public assemblage: All buildings designed or occupied for the purpose of amusement, entertainment, social intercourse, or worship.

Class 4—Buildings of a semi-public nature: All buildings to which the public has access, and which are designed or occupied for the service of the general public.

Class 5—Mercantile buildings: All buildings or parts of buildings designed or used for the sale of merchandise, objects of utility and supplies.

Class 6—Industrial buildings: All buildings or parts of buildings designed or occupied for the manufacture, use, or storage of merchandise, objects of utility and supplies.

Class 7—Garages: Buildings or parts of buildings designed or occupied for the storage, repair, or housing of automobiles when containing volatile or highly inflammable fuel.

Class 8—Residence buildings: All buildings or parts of buildings designed or occupied for family residence purposes.

Class 9—Buildings for housing of animals: All buildings or parts of buildings designed or occupied for the shelter, stabling, or housing of animals.

Class 10—Miscellaneous buildings: It will be noted that the above classification has not as yet accounted for the variation in the inflammability of the contents or number of occupants in buildings of the same classification. This is to be done by again appropriately subdividing each class.

Fire Hazard

This subdividing should be done in the case of the No. 1 or occupancy group into those buildings which have a relatively large or small number of occupants and those in which the distribution of occupants may become hazardous, as when they sleep on the premises or have a tendency to become panic-stricken or in which occupants are forcibly detained.

In the case of No. 2, by sub-classifying according to the relatively high or low inflammability of contents this would indicate the following typical subclassification of each of the foregoing classes: (a) When contents have high flamability; (b) when contents have moderate flamability; (c) when contents have low flamability; (d) when contents have very little flamability.

Again, each of the above will subdivide accordingly as the fires are flash fires or long fires, hot fires, or relatively cooler fires. This separation must be studied out for each municipality according to its individual needs and rapidity of growth, and is too intricate a subject for detail treatment in a short paper.

In order to provide appropriate structures which will adequately provide for the above contingencies the regulations naturally divide themselves into the two groups mentioned before: I. Exit facilities. II. Fire prevention and resistance.

Exit Facilities and Fire Prevention

A description of the general principles underlying each follows:

I. Exit facilities may be provided with little trouble by remembering that it is wrong to have less than two means of egress; that the width of exits should be in proportion to the number of occupants, and so located and arranged that exit will be direct and sure. In order to make exit safe in buildings of high flammability the enclosures around the stairways should be made fire-resistive in proportion to the fire hazard.

II. The subject of fire protection and fire resistance, which until very recent times was not thought to be a legitimate field for engineers, is now known to be one of the most intricate problems science has had to solve. We are only just beginning to grasp the problem.

This subject is to be studied from two angles—one being the degree of fire to be resisted, and the other the design of fire-resistive materials.

Classification of Fire Hazards and Resistances

After much study and discussion, a joint committee of a number of learned societies have tentatively decided upon standard fire classification for fire hazards by rating some twelve hundred different occupancies into groups relatively to each other. These have appeared to the writer to come in three classes: "A," high flammability; "B," moderate flammability; "C," low flammability.

The same learned societies have accordingly classified three degrees of fire resistance. The fire-resistive materials are to be classified by test. The class to which the material belongs will be determined by a time temperature test. The National Fire Protection Association has defined three grades of fire protection as: (1) Four-hour protection; (2) two-hour protection; (3) one-hour protection.

The writer does not agree at all with the last two of these, for many reasons, both from the physical standpoint and that of general advisability. In his work the author has, with good reason, classified the grades of fire-resistive construction as follows: (1) Four-hour fire protection; (2) three-hour fire protection; (3) two-hour fire protection.

Fire-Resistive Construction

Next in order comes the classification of buildings with respect to types of construction of equivalent resistance to the danger or hazard. This classification or grading of construction should provide for the essential portions of the building, such as structural frame, enclosure of building, enclosure of vertical openings through floors, such as enclosed fire exit stairways, shaftways for elevators, etc. The proper grading for fire-resistive buildings only is here given, in which all parts resisting stresses and carrying loads are protected from the effects of fire by insulating materials capable of passing the fire test required. The first four grades are given by the table:

	Structural Frame.	Roof.	Stairs, shafts, and openings.
Grade "A"	4-hour	3-hour	4-hour
Grade "B"	3-hour	2-hour	3-hour
Grade "C"	2-hour	2-hour	2-hour
Grade "D"	Incombustible materials unprotected by fire-resistive materials.		

The following classifications come next in order, but are, however, not classed as fire-resistive construction:

Grade "E"—Slow-burning or wood frame construction of heavy or mill type.

Grade "F"—Masonry enclosing walls with ordinary wood joisted construction and frame.

Grade "G"—Wood frame construction, with veneer of masonry to protect from weather.

Grade "H"—Wood frame construction.

Formulation of Code Is a Science

The building of a building code is deserving of being called a science. Enough scientific subjects come under its provisions to occupy a corps of building experts, engineers, and scientists for many years to come. It is capable of being—and to be properly planned should be—subjected to a very scientific analysis. Complete analysis would disclose the fact that the foregoing article has only scratched the surface—has only indicated the principle matters, without stating, explaining, or reasoning out any of the vital detail. So far as the classification of the principles of building law and reasoning in a constructive manner to produce a logical result is concerned, the writer finds little has been heretofore done. What is needed is more widespread study of a constructive plan for a proper building law.

Substitute for Sheet Steel

In England a substitute for sheet steel for various purposes has been found in an asbestos-cement composition. Ground asbestos is mixed in the proportion of one to six with portland cement and worked into a paste with water. A machine something on the order of those used in making paper forms it into sheets, which are trimmed to size and, if desired, corrugated for roofing purposes. After seasoning the material is ready for use. It is durable, resistant to climatic conditions, particularly acids in the atmosphere, fireproof, and also a non-conductor of heat.

Production and Consumption of Building Materials

A REPORT just issued by the Department of Mines for the calendar year 1916 contains a quantity of information of interest to the building trade. The materials included are cement, clay products of various kinds, such as brick, sewer pipe and tile, pottery, etc., lime, sand-lime brick, sand and gravel, slate, and stone for building and other purposes, including granite, marble, limestone, sandstone, etc. A summary of the production of these various materials during the years 1912 to 1916 is shown in Table 1. It will be noted that there was an increase in volume in 1913 and decreases for 1914, 1915, and 1916, the drop in 1916, however, amounting to only 2.5 per cent., as compared with the previous year.

TABLE I.

	1912	1913	1914	1915	1916
Cement	$ 9,016,556	$ 11,019,418	$ 9,187,924	$6,977,024	$6,547,728
Clay products	10,575,869	9,504,314	6,871,957	3,914,488	4,120,805
Lime	1,844,849	1,609,398	1,360,628	1,015,702	1,091,463
Sand-lime brick	1,020,386	906,665	609,515	141,742	126,235
Sand and gravel	1,512,099	2,258,874	2,505,310	1,624,767	1,838,320
Slate	8,939	6,444	4,837	2,039	6,223
Stone	4,726,171	5,504,639	5,469,056	4,244,997	3,736,412
Total	28,794,869	30,809,752	26,009,227	17,920,759	17,467,186

Cement

The total quantity of cement manufactured in 1916, according to returns received from the manufacturers, was 4,753,033 barrels of 350 pounds net each (831,781 tons), as compared with 5,153,763 barrels (901,909 tons), made in 1915, a decrease of 400,730 barrels 70,128 tons), or nearly 7.8 per cent. The sales during this year exceeded the output, and the quantity held in stock at the end of the year showed a decrease of 618,086 barrels, as compared with 1915. The average price per barrel at the mills for all plants, with the exception of those in Manitoba, had been steadily falling up till 1916, being $1.22 in that year, as against $1.23 in 1915, $1.28 in 1914, $1.27 in 1913, $1.27¾ in 1912, and $1.34 in 1911.

In Table II. is shown the annual consumption of portland cement, both Canadian and imported, for the years 1901 to 1916. It will be noted that the imports have decreased fairly regularly, except in the years 1910, 1911, and 1912, from 64 per cent. in 1901 to 0.4 per cent. in 1916.

Ontario continues as the most important cement-producing province in Canada, having sixteen completed plants, with a total daily capacity of 19,850 barrels, at the end of 1916. Quebec comes next, with three cement mills, having a total daily capacity of 16,600, according to the figures then compiled. The total production in the Dominion during 1916 was derived from fifteen plants. Fourteen other plants were idle throughout the year, one of them, however, making shipments from stock. The total daily capacity of these twenty-nine plants is 53,415 barrels.

Clay and Clay Products

The clay products made in Canada comprise brick of various kinds, fireproofing blocks, sewer pipe and drain tile, pottery and sanitary ware, the last two products chiefly from imported clays.

The total value of the clay products sold or marketed in 1916 was $4,120,805, as compared with $3,914,488 in 1915, $6,871,957 in 1914, $9,504,314 in 1913, and $10,575,869 in 1912. The production in 1916 showed a slight increase over 1915—$206,317, or 5.3 per cent. It was but little over one-third the maximum production reached in 1912.

For a few years previous to 1913 the annual production of clay products increased very rapidly, having more than doubled in that period. In 1913, however, the financial stringency affected building operations to such an extent as to greatly reduce the demand for building brick. There was actually a considerable increase in the quantity of common and pressed building brick manufactured during the year, but a large falling off in sales, so that large stocks of brick must have remained in manufacturers' hands at the close of the year. In 1914, and again in 1915, there was a large falling off both in quantities of brick made and in quantities sold. Sales in 1915 exceeded actual output, stocks having been depleted considerably to supply the demand. All classes of clay products showed a falling off in production, with the exception of firebrick, pottery, and kaolin. During 1916, however, the total quantity sold was about the same as that manufactured, while stocks of common and pressed brick held on hand at the close of the year fell to slightly over 100,000, and all classes of clay products showed increased sales.

Of the total value of the sales in 1916, building and paving brick, including fireproofing, contributed $2,732,000, or about 66.3 per cent., as against $2,571,153, or about 65.6 per cent. of the total in 1915. Sewer pipe and tile production in 1916 were valued at $1,075,674, or 26.1 per cent. of the total, as against $1,154,742, or 29.5 per cent. of the total in 1915.

The average price of common building brick for the whole of Canada in 1916 was $7.71 per M., as compared with $7.48 per M. in 1915, $7.99 in 1914, $8.85 in 1913, $9.11 in 1912, $8.37 in 1911, and $8.13 in 1910. The average prices of pressed, or front, brick for the same years were respectively $10.95, $9.89, $11.91, $12.40, $12.86, $12.53, and $11.89, thus showing a general increase in the cost of building brick until 1912, falling off again in 1913, 1914, 1915, with a higher price ruling again in 1916, though still less than any previous year with the exception of 1915. These figures are the values at the kilns, and, not including the cost of delivery, do not represent the actual price to the consumer.

TABLE II.--CONSUMPTION OF CEMENT IN CANADA.

Calendar Year.	Canadian.		Imported.		Total.
	Barrels	Per cent.	Barrels.	Per cent.	Barrels.
1901	317,066	36	555,900	64	872,966
1902	594,594	52	544,954	48	1,139,548
1903	627,741	45	773,678	55	1,401,419
1904	910,358	54	784,630	46	1,694,988
1905	1,346,548	59	918,701	41	2,265,249
1906	2,119,764	76	665,845	24	2,785,609
1907	2,436,093	78	672,630	22	3,108,723
1908	2,665,289	85	469,049	15	3,134,338
1909	4,067,709	97	142,194	3	4,209,903
1910	4,753,975	93	349,310	7	5,103,285
1911	5,692,915	90	661,916	10	6,354,831
1912	7,132,732	83.3	1,434,413	16.7	8,567,145
1913	8,658,805	97.1	254,093	2·9	8,912,898
1914	7,172,480	98·7	98,022	1·3	7,270.502
1915	5,681,032	99·5	28,190	0·5	5,709,222
1916	5,369,560	99·6	20,596	0·4	5,390,156

Ontario is by far the largest producer of clay products, having contributed in 1916 over 52 per cent. of the total values marketed during the year as against nearly 58 per cent. of the total values marketed during 1915. Quebec contributed 24.1 per cent. in 1916, as against 23.5 per cent. in 1915; Alberta 5.5 per cent. in

1916, as compared with 2.9 per cent. in 1915; Manitoba 2.5 per cent. in 1916, as against 2.4 per cent. in 1915; and British Columbia 7.1 per cent. in 1916, as compared with 5.8 per cent. in the previous year. Nova Scotia contributed 5.8 per cent., as against 5.7 per cent. in 1915.

The total value of the imports in 1916 was $4,554,167, and, after deducting a small export, a total approximate consumption of clay products valued at $8,594,860 is shown, of which 48 per cent. was of domestic production. For the seven years previous the consumption was as follows: 1915, $6,867,381, of which 57 per cent. was of domestic production; 1914, $11,291,024, of which about 61 per cent. was of domestic production; 1913, $16,212,733, of which 58.6 per cent. was of domestic production; 1912, $17,149,659; 1911, $13,516,477; 1910, $11,958,591; 1909, $9,696,324, of which 70 per cent. was of domestic production.

In the case of building brick the imports are small compared with the home production, amounting to not much more than 5 per cent. of the latter.

Clay Paving Brick

This brick is made chiefly at West Toronto, Ont., from shale obtained from the banks of the Humber River, although during the past few years there has been a production reported from Clayburn, B.C. The imports, however, during the past five years have considerably exceeded the domestic production.

Fireclay and Fireclay Products

The total value of the sales of fireclay, firebrick, and fireclay products in 1916 was $234,562, as compared with a valuation of $110,693 in 1915. There was, in addition, in 1916, a production of fireclay products valued at $22,484 reported as being made from imported clays. The production in 1916 included fireclay, or refractory clay sold as such, 9,206 tons, valued at $30,767; firebrick, 5,688,511, valued at $147,757, or an average of $25.97 per thousand; and other fireclay products valued at $56,038. The production in 1915 included fireclay and refractory clay sold as such, 2,328 tons, valued at $12,065; firebrick, 2,895,640, valued at $68,700, or an average of $23.73 per thousand; and other fireclay products valued at $29,928.

Sewer Pipe and Drain Tile

The total value of the production of sewer pipe in 1916 was $716,287, as compared with a value of $799,446 in 1915, $1,104,499 in 1914, and $1,035,906 in 1913. About 45 per cent. of the production in 1916 was made in Ontario. The 1916 imports of drain pipe and sewer pipe were valued at $40,233 and the 1915 imports at $41,801.

The total sales of drain tile in Canada in 1916 were valued at $359,387, as compared with sales of $355,296 in 1915 and $366,340 in 1914. The greater part of this production is in Ontario, the sales in this province, as reported by the producers, being 20,205,837, valued at $343,677, as against 18,812,712, valued at $341,467 in 1915.

Lime

The production of lime, which in 1916 amounted to 5,493,250 bushels (equivalent to about 192,264 tons), valued at $1,091,463, or an average of 20 cents per bushel, or $5.75 per ton, shows an increase of 446,006 bushels, or 8.8 per cent. over the 1915 production, of 5,047,244 bushels (equivalent to about 176,654 tons), valued at $1,015,702, also an average of 20 cents per bushel.

In 1914 the production was 7,028,582 bushels (equivalent to about 246,000 tons), valued at $1,360,628, an average of 19 cents per bushel, or $5.53 per ton.

The Province of Ontario is the principal lime-producing province, having in recent years contributed from 30 to 42 per cent. of the total output. In 1916 the contribution was 37 per cent. of the total production.

Sand-lime Brick

Sales in 1916 were made very largely from stock, since the total number of brick made during the year was reported as only 13,884,400, while stocks at the end of the year amounted to 5,178,175.

Sand and Gravel

The production of sand and gravel in Canada during 1916 was 8,156,207 tons, valued at $1,838,320, showing an increase in quantity of 1,710,490 tons, or 26.5 per cent., and an increase in value of $213,553, or 13.1 per cent., as compared with the production reported for 1915. The value of the production for the years 1912, 1913, 1914, and 1915 is respectively as follows: $1,512,099, $2,258,874, $2,505,310, $1,624,767.

The 1916 production included: Building sand and sand for concrete and road building, etc., 1,379,319 tons, valued at $475,811; gravel and crushed gravel, 553,125 tons, valued at $162,250; sand and gravel, 1,505,775 tons, valued at $605,280; railway ballast, 4,559,689 tons, valued at $521,189; moulding sand, 19,251 tons, valued at $16,726; and other sands (mostly engine sands), 139,051 tons, valued at $57,064.

Slate

There is a small annual production of slate in Canada, obtained from the New Rockland quarries, Melbourne Township, Richmond County, operated by Messrs. Frazer & Davies. The production in 1916 was 1,262 squares, valued at $6,223, as compared with a production in 1915 of 397 squares, valued at $2,039, and of 1,075 squares, valued at $4,837 in 1914.

The total value of the imports during the calendar year 1916 was $96,776, and included: Roofing slate, 4,412 squares, valued at $21,335; school writing slate, $35,887; slate pencils, $11,309; and other slates and manufactures of, $28,245. The total value of the imports during the calendar year 1915 was $108,676, and included: Roofing slate, 7,483 squares, valued at $34,528; school writing slate, $38,874; slate pencils, $4,954; and other slates and manufactures of $30,320.

Stone

The total value of the production of stone in 1916, according to returns received, was $3,736,412, a decrease of over 12 per cent. from 1915. This comprised granite, at a value of $1,247,267; limestone, valued at $2,224,091; marble, $118,810; and sandstone, $146,244. The percentages according to values used for various purposes was as follows: Building, 31.4 per cent.; ornamental and monumental, 4.9; paving and curbstone, 2.0; rubble, 11.1; crushed, 37.7; furnace flux, 12.9. In 1915 the value of the production was $4,244,997, distributed as follows: Granite, $1,525,553; limestone, $2,312,081; marble, $158,027; sandstone, $249,336. The value of the imports of stone in 1914, 1915, and 1916 were respectively as follows: $1,252,869, $539,173, $587,304; and the exports for the same three years were respectively $72,080, $72,777, $143,988. It will be noted that the export figures for 1916 are about double the previous years.

In the above figures stone used for burning lime or manufacturing cement is not included.

Fuel Conservation Through Smoke Regulation

Smoke Means Waste and Poor Combustion—Its Abatement Conserves Fuel and Produces Savings in Other Directions

By J. W. Henderson[*]

A FORMER president of the United States, in a special message to Congress on the subject of conservation, said: "The underlying principle of conservation has been described as the application of common sense to common problems for the common good." Conservation that merely contemplates witholding the natural resources from use, keeping them in their natural state, can hardly be considered conservation in its broadest application. Common sense would dictate conserving them from their natural source through the processes of production, distribution, and consumption.

The problem is based on the assumption that the people of the country as a whole are the rightful owners of all the natural resources. It naturally follows that the federal government is the only power to be depended upon to act in the capacity of storekeeper and managing director of those natural resources. Conditions resulting from the great world war have established this relationship of the federal government and made its position acceptable to the people.

The logical starting point is that of "taking stock" of the natural resources. Having this knowledge, conservation can be carried on, on the basis of "the application of common sense to common problems for the common good."

Smoke Means Waste

The fuels of the country are, perhaps, the most important natural resources, particularly at this period of our history with the success of the great war being dependent upon the availability of their supply. Under this heading and as relating to the subject of this paper the term "fuel" has reference to the following: Wood, coal, oil, gas and their by-products.

Investigations and experience demonstrate that the production and emission from stacks of smoke prohibited by law means **waste**—direct waste of combustible materials and their by-products, and contributory, contingent waste of building materials, household goods, vegetation, and of human energy, both physical and mental.

Most of the large cities and some smaller ones have on their statute books laws regulating the production and emission of smoke from stacks. Generally the production and emission from a stack of "dense smoke" beyond a specified number of minutes in a certain period of minutes constitutes a violation of the law.

In a few cases in the United States the work of smoke regulation is under state control. Many foreign countries have realized the importance of the question by placing it within the activities of their central governing powers. Having heard of the progress of the work in Pittsburg, the Bengal Smoke Nuisance Commission, Calcutta, India, and officials in Tokio, Japan; Melbourne and Sydney, Australia; England and Canada, and in twenty-nine states have made enquiries as to the methods employed in carrying on the work in Pittsburg.

The work in Pittsburg has proven that smoke regulation is essentially a fuel conservation problem. But, disregarding our experiences and the specific instances where the facts confirm this conclusion, and antedating our appointment to office at the beginning of the present city administration, you will find evidence in the publications of the Mellon Institute of Industrial Research, of the results of their investigation of the smoke nuisance, to cause you to come to the same decision in this matter.

Smoke means waste. It is evidence of incomplete combustion. It is produced by users of wood, coal, oil, and gas. Proper smoke regulation results in saving these fuels. Conservation as proposed will induce complete combustion of them and stop the production of smoke.

Smoke regulation is so closely related to conservation as to indicate the necessity of the government taking it into consideration in its program of conserving the country's natural resources. The work cannot be of a constructive and permanent character if left to the fluctuating political activities of the cities, counties, or states.

An important phase of the case is that of the larger governmental units not being amenable to the laws and regulations of the smaller units. Many of the government plants have been found violating city laws, and any action taken towards meeting the regulations has been only in the nature of courtesy and not as recognizing any responsibility under the city law. The same is true of county and state institutions.

Numerous means have been proposed for doing away with the "smoke nuisance." Considerable time and energy have been spent in devising patented devices for catching the smoke when the merest tyro in combustion should know that this is but multiplying the loss. The way to meet the requirements is to not make the smoke in the first place. This is accomplished by securing more perfect combustion. And this is in line with the work of conservation.

Smoke Abatement Saves Fuel

Smoke abatement accomplished in the most intelligent manner saves fuel and labor and, in the case of industrial plants, generally aids in increasing the output of improved products. At the same time, in many instances, profits are realized by recovery of by-products. The writer has in mind a certain coke plant where, under present practice, there is a loss of gas sufficient to supply the heating requirements of about 30,000 homes. Accompanying this loss are the tar, ammonium sulphate, benzol, and other valuable by-products which might be recovered under more modern methods of production.

Smoking stacks are indicators pointing to plants and furnaces where fuel is being needlessly wasted and where regulation can and should be applied immediately. Given two plants turning out an equal quantity of the same kind of materials, the wasteful plant should be compelled to attain to the efficiency of the one consuming the smaller quantity of fuel. One of these plants should not be permitted to use 1,000 tons of coal a day if a competitor is securing the same production through the use of but 750 tons per day.

Journey in any direction and smoking stacks are everywhere in evidence, showing the widespread inefficient use of fuel. This is true in the small town as well as in the case of the large cities having important industrial centres.

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[*] Chief of Bureau of Smoke Regulation, Pittsburg, before American Association for the Advancement of Science.

In Pennsylvania only cities of the first and second class have been authorized by the legislature to "regulate the production and emission of smoke from stacks." This leaves the smaller communities without any remedy in the matter of protection from polluted air and the destruction of buildings, household goods and wearing apparel, not to say anything about their individual interest in the conservation of the natural resources of the country.

Pittsburg spends annually less than $14,000 in maintaining its bureau of smoke regulation in the Department of Public Health. There are numerous cases where plant owners have been compelled to make changes to furnaces that have resulted in saving of fuel and labor to this amount and more. In one case a new plant was put in, costing $130,000, and the economies resulting exceeded $60,000. This is the most marked case, but it is typical of the possibilities.

Savings in Other Directions

Disregarding all direct reductions in operating expenses and lowering of expenditures, just consider what smoke regulation may mean to the people in general in, say, the smaller item of laundry expense. Consider that the cleaning cost has been reduced a little less than 4c per week, or $2 per year, per person in the city of Pittsburg, having a population of 600,000 individuals. This means a saving of $1,200,000 annually. The local United States weather records show the smoke has been reduced about 75 per cent. The Mellon Institute investigation placed the cost of the smoke nuisance at its worst at $10,000,000 annually to the people of Pittsburg.

Canadian Society of Civil Engineers Elections and Transfers

The following have been elected members, associate members, juniors, etc., of the Canadian Society of Civil Engineers:

Members—Mr. Wiliam R. Bonnycastle, Vancouver, B.C., private practice as consulting hydro-electrical engineer, specializing on water-power development, engineer for the Bridge River Power Company and Indian River Power Company, of British Columbia; prior to that electrical engineer with Stave Lake Power Company and hydraulic and electrical designing engineer with the Western Canada Power Company, and also engineer for Smith, Kerry & Chace; Mr. D. T. Main, Winnipeg, with the C.P.R. since 1904, and now works manager, Winnipeg.

Associate members—Mr. T. C. Connell, La Loutre Dam, P.Q., with the St. Maurice Construction Company, as chief assistant to Mr. Luscombe, chief engineer of La Loutre Dam; Mr. C. P. Howrigan, East Fairfield, Vt., U.S.A., with Fraser, Brace & Co., in charge of railway construction and assistant superintendent La Loure Dam, P.Q.; Mr. E. N. Johnson, Regina, Sask., resident engineer on construction, C.P.R., East End, Sask., and, prior to that lieutenant with Canadian Engineers and Royal Engineers in France; Mr. T. C. Main, Winnipeg, formerly with C.N.R. on various engineering works, and at present in charge of construction and maintenance of Seres Road in Salonika, with 139th Army Troop Company, Royal Engineers; Mr. A. F. Mitchell, Victoria, B.C., acting district engineer for Major-General G. B. Hughes, D.S.O., C.B., in charge of railroad improvements, Victoria and Nanaimo, construction and maintenance of Dominion Government wharves, Esquimalt graving docks, quarantine station, wharves, roads, and pipe lines and other works of the department in Vancouver; Mr. E. B. Tilt, Madrid, Spain, president and general manager, Sociedad Hispano Americano; Gaston Williams, of Wigmore, C.A., Madrid, prior to that chief inspector of steel, Imperial Munitions Board; Mr. D. O. Wing, Toronto, British Columbia land surveyor, and formerly on D. L. S. Survey for Department of Interior.

Juniors—Mr. L. J. Devereux, Prince George, B.C., assistant engineer G.T.P,, on maintenance and in responsible charge of bridges and construction of depots, etc.; Mr. Ulric R. Moore, Ottawa, adjuster, Imperial Munitions Board, and previously acting chief office and assistant engineer on Welland Ship Canal; Mr. J. A. MacGillivray, Point du Bois, Lac du Bonnet, Man., resident engineer on extension of city of Winnipeg hydro-electric plant at Point du Bois, with W. M. Scott.

Transferred from associate member to member—Mr. C. E. Henderson, St. Augustine, Fla., county engineer, St. John's County, Fla., in charge of design and construction of reinforced concrete bridge and fifty-five miles of paving.

Transferred from junior to associate member—Mr. W. S. Ford, Stave Falls, B.C., with Royal Garrison Artillery, second lieutenant 122nd Siege Battery, B.E.F., France, and formerly with Western Canada Power Company, Stave Falls, design of plants, etc.

Transferred from student to associate member—Mr. S. Bourgoing, Montreal, assistant engineer city of Montreal, supervising construction of sewers for western division; Mr. F. W. Douglas, New York, with Foundation Company, of New York, as resident engineer on various contracts, and formerly assistant to P. B. Street on survey of Dominion lands along Hudson Bay Railway; Mr. J. S. Galbraith, "somewhere in France," with 123rd Canadian Pioneer Battalion, Royal Grenadiers, prior to that on various engineering work and demonstrator in the fourth year, Faculty of Applied Science and Engineering, University of Toronto; Lieut. C. N. Mitchell (M.C.), Canadian Engineers, No. 1 Tunnelling Company, B.E.F., France, and formerly engineer on the straightening of the C.P.R. elevator, North Transcona, Man.

Transferred from students to juniors — Mr. J. H. Dupuis, Montreal, civil engineer for Mr. Malcolm D. Barclay, A.M.Can.Soc.C.E., Montreal; Mr. C. A. Buck, Toronto, Brinell testing engineer for Imperial Ministry of Munitions in the Toronto district; Mr. W. F. Noonan, Kingston, Ont., civil draughtsman, C.R.C.E. office, Military District No. 3, Kingston.

The final report of the International Joint Commission in the Lake of the Woods Reference has just been published in bound form, stiff linen cover. The report covers 260 pages and includes some 54 illustrations. It is the work of Lawrence J. Burpee and Whitehead Kluttz, secretaries respectively of the Canadian and the United States sections of the International Joint Commission.

The Report of the Roads Department of the Province of Quebec for the year 1917, as submitted to the Lieutenant-Governor of the Province by Hon. J. A. Tessier, Minister of Roads, has recently been issued.

Steam Road Rail Failures

Paper Before Association for the Advancement of Science Discusses Causes and Remedies of Track Defects

By G. H. Barbour

STANDARD steam road track as generally constructed in this country comprises a well-drained subgrade of compressible soil whereon is spread and compacted a cushion of broken stone ballast from 15 to 24 inches in depth, on which are strung at intervals of about 22 inches, 7 by 9 inch by 8½ ft. wooden crossties, to which are spiked, often with the interposition of flat or inclined metal tie-plates, steel rails in 30 to 33 ft. lengths, and ranging in weight per yard from 85 lbs. on sidetracks and minor roads, to 100 lbs. on mainline tracks of more important right-of-ways. I purposely reserve inclusion of the recent 130 to 136 lb. installations, as their use so far is restricted.

The ordinary observer visualizes a solid structure, but steam road track is anything but restful and quiescent under the hurtling mass and projectile impulse of the fast-flying equipment. The rails undulate and wave, the crossties rise and fall and the whole track depresses under the wheel contacts of the train, which subsidence is in direct proportion to the weights on the wheels, the depth of the ballast and the compressibility of the latter and of the subgrade, and inversely to the area of crosstie bearing upon the ballast; except as Dr. Dudley has established, that the maximum subsidence occurs approximately under the center of gravity of the combined locomotive and tender, due probably to the projectile impact of the gigantic mass with its dynamic augments. This subsidence from which the track returns to its normal level or trackmen's surface directly the train has passed, very aptly has been named the transitory depression.

Shallow Rail Has Lower Stresses

While the cushioning action of the compressible ballast and subgrade and the resultant undulations of the rail are the salvation of railroading, excessive deflections are perilous; for, as no conceivable rail is of sufficient strength to more than follow the vertical curves of the transitory depression, its extreme fibers are bound to experience the stresses induced by such curves. Hence the advisability of reducing the depth of the ballast and of increasing the bearing area of the crossties, since Dr. Dudley has established that from 75 to 80 per cent. of the subsidence occurs in the ballast and the remainder in the subgrade. And grave danger is involved in increasing the height of the rail to obtain the requisite girder strength now that 85 to 100 lb. rails are found to be inadequate; for, as the magnitude of the stresses induced in the extreme fibers of the rail by the curves of the transitory depression are directly as the distances of those fibers from the rail's center of gravity, the lower the rail the less the amounts of those stresses.

An unappreciated feature of track is the sufficiency and frequency of the rail's lateral fastenings. "Turned-out" rails and spikes "forced back into the wood" are of common occurrence and reveal the magnitude and intensity of the lateral forces. Double fastenings could be provided for each crosstie were broader ones adopted.

The rail is commonly considered a girder spanning from crosstie to crosstie. It has been demonstrated, however, that the span from wheel to wheel wherein the wheel loads are compensated by the reactions of the ballast-bearing of the crossties governs the maximum vertical bending moment; and that the maximum combined stresses are experienced at a wheel contact when it occurs half way between a pair of crossties, for, in that position, the lateral forces produce the greatest horizontal bending moment. The head of the rail is in compression at the wheel contacts and in tension between them and its base, and vice versa. Hence continually repeated reversals of stress and alternate vertical deflections result as the wheels traverse their attendant transitory depression. Independent of magnitude and spacing is the importance of so loading the locomotive wheels that heavy loads should not have wide spacing. An ideal loading would have the forward truck wheel the lightest with a gradual increase to the middle driver and a tapering off to the trailer, which should not have over two-thirds the static load of the main driver. A great many locomotives produce greater stresses under the trailer than anywhere else, to which its position approximately under the center of gravity of the combined engine and tender and its wider spacing are contributary.

The Joint is the Great Defect

The joint is the great defect in rails, due to 14 inches more or less of the railend being held so rigidly in the vise-like grip of the splicebars that it cannot deflect freely. For this condition there is no cure, though it can be ameliorated by diminishing the depth of the transitory depression, as already described, and by the use of a splicebar contacting with the rails only at its ends and center.

Other defects, even in such heavy installations as the 130 lb. PRR and 136 lb. Lehigh Valley rails, are lack of lateral strength, insufficient width of head and low center of gravity. In rail design the problem is not only to satisfy the vertical loads on the wheels plus their dynamic augments, together with the lateral forces resulting from the swaying, lashing and tangential impulses of the equipment, but also to compensate the accompanying torsional or polar moments, which are, first, the product of the lateral forces by the vertical distance from top to center of gravity of rail (their lever arm) and, second, the product of the load on the wheel by the horizontal distance from the rail's vertical axis to the center of the black streak or line of wheel contact which generally occurs on the outside of the railhead. At the same time it should be borne in mind that the height of the rail should be maintained at the minimum to relieve the critical fibers of its head during the transitory depression, because the head is the point of peril on account of the peening punishment of the impinging wheels, the grinding action of their flanges and the friction of their brake-bound treads, cumulatively aggravated as the wheels become ragged and worn. These considerations are best met by making the railhead broader in order to bring the black streak nearer its center; by raising the rail's center of gravity to reduce the torsional lever arm of the lateral forces as well as the distance from the center of gravity to the critical fibers of its head; by increasing the rail's lateral strength to resist the horizontal bending moment as well as to augment its polar or torsional section modulus; and withal, by striving for the lowest rail that will provide the necessary girder strength and satisfy the above conditions.

Investigation of Accident

As particularly pertinent to the proposition, note the following excerpts from the report, dated Feb. 12, 1917, of the chief of the Division of Safety, Interstate Commerce Commission, covering the investigation of an accident which occurred on the Galveston, Harrisburg and San Antonio Railway, near Iser, Tex., January 31, 1916:

"The direct investigation of the rail which ruptured attaches the causes of its failure to the development of transverse fissures in different parts of its length. Transverse fissures are held to represent a modified type of fatigue fracture, the formation of which is due to repeated alternate stresses received in the track. A fatigue fracture is one which results from the repetition of loads too great for the steel to long endure. It is a progressive fracture in its usual development, one to which the name "detail fracture" is often applied. It is gradual in its development, chiefly when the loads which cause it are variable. It is a tension fracture and occurs where the tension stresses reach a maximum. In a rail, the greatest tension in the head is along certain interior elements, by reason of the initial strains of compression set up at the running surface by the cold-rolling of the wheels. The location of the metal in maximum tension accounts for the interior origin of transverse fissures, which is a distinguishing feature over other fatigue fractures where the compressive component is not present. Incipient fissures are found at frequent intervals along the interior elements of the head in rails which have failed in this manner. The same is true in fatigue fractures made in the laboratory. The integrity of the steel is destroyed locally, and fine checks appear on the surface of the bars when they are subjected to direct tension stresses, after failure under repeated loads. Experimentally, transverse fissures have been made in new rails, where control over their location in the head has been demonstrated. They were located at will, centrally over the web, and on the right side or the left side of the head, according to that on which the load was applied."

No Definite Cause for Fissures

"Neither chemical analyses or microscopic examinations have shown a definite cause for the development of transverse fissures, and they develop in rails which are structurally and chemically free from any known defect. They preponderate on the gauge side of the head and the side on which the wheels have the greatest effect. They have occurred in rails of different weights; in those of different 'ingot positions'; in the product of each of the two great methods of steel making, Bessemer and open-hearth; in direct-rolled rails and in those from reheated blooms; in rails laid on curves and in those on tangent track; over ties and between them. They have made their appearance in the different seasons. They occur where, according to chance, the rail may have been gagged and, from the number and proximity of the fissures, where they probably were not gagged. They have displayed themselves singly, and independent of other types of rupture, and also associated with shearing fractures or seams which have developed at right angles to the fissures. They are found in the head and not in the base of the rail. They appear in rails which show very little wear; they are not confined to any one rail mill, nor to northern or southern mills, nor to any year's rolling, but have been displayed by rails rolled at periods of time separated by at least two decades. The latter fact should remove doubts concerning any peculiar conditions having found their way into modern mill practice, influencing this type of failure. On the other hand, traffic has increased, wheel loads have increased, and speeds have increased; and transverse fissures are in general found where these conditions are well advanced. The girder strength of the rails has been increased, while the impinging pressures of the wheels still remain without amelioration. It is a disquieting matter that rails of the heavier sections recently laid have displayed transverse fissures. Mere increase in weight of section has not brought with it immunity from failure in this manner."

Result of Repeated Stresses

"The general law enunciated some 50 years ago in respect to the invariable result of repeated stresses in causing rupture in sound steel, and without display of ductility, applies to this type of fracture. To this law there are no exceptions. The continued use of rails without exact knowledge upon their resistance to repeated alternate stresses, which constitutes their regular function in service, and without exact knowledge upon the magnitude of the track stresses which they daily receive, presents an engineering anomaly which has extended far beyond its proper limits of time. The continued use of steel rails without fundamental information is unjustifiable. Data are needed upon the magnitude of the track stresses, and upon the limit of endurance of rails to such repeated stresses. The magnitude of the loads received and the number of repetitions are factors which determine the life of the rail against fatigue fractures. The satisfactory use of rails requires the determination of this information, with such limitation placed upon the number of repetitions of loads that a proper margin of residual strength shall be maintained."

Dr. James E. Howard, engineer-physicist of the Commission's Division of Safety, might have added, "or with such limitation placed upon the depth or degree of deflection as would allow the maximum number of such repetitions;" for, naturally, the rail would endure more repeated alternate vertical deflections of a less than of a greater degree; an added argument for reducing the depth of the transitory depression under the moving equipment by increasing the area of crosstie bearing on the ballast, diminishing the depth of the ballast, and maintaining the height of the rail at a minimum. A thin spring will withstand more flexures of the same degree than a thick one.

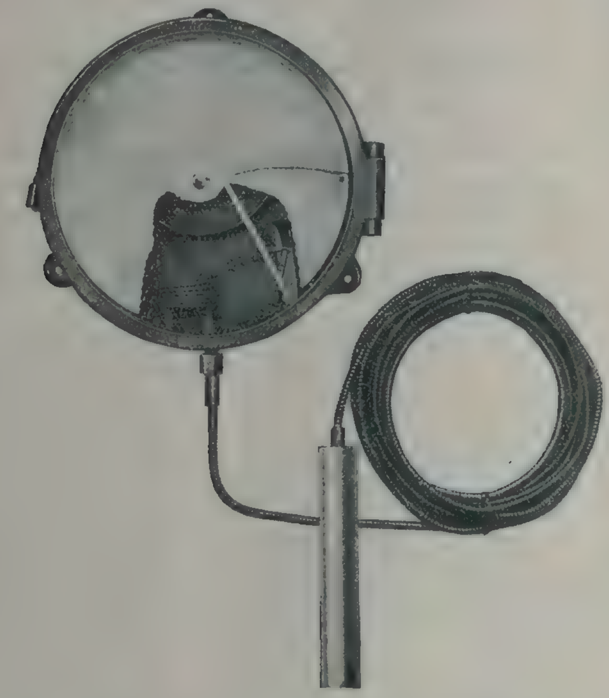
Prices Still Increasing

Business in building supplies in Montreal is very dull, even for this time of the year. Prices, too, of several commodities have again advanced, so that it seems as if the period of cheaper building, which some expect, and which has resulted in many projects being postponed, is still a long way off. The advocates of "build now" are apparently being justified in their view that prices will tend to increase rather than diminish.

The annual meeting of the Montreal Builders' Exchange will be held on January 28, in the rooms of the exchange, Drummond Building.

The Sanborn Pressure Recorder

THE Sanborn pressure recorder shown in the accompanying cut is designed to overcome the defects of other types of automatic gauge recording devices by obviating stilling wheel, floats and rubber diaphragms. The outfit, which is used for gauging streams, sewers, etc., comprises the recorder, compensator, or inlet tub and the connecting tubing. The recorder may be placed at any convenient distance above the water surface or away from the inlet and still record the variations in depths of flow. The device is operated by a set of corrugated diaphragms, the movement of which is transmitted to a recording pen arm by a simple mechanism that consists of two levers and axis. After the inlet tubing or compensator has been lowered into position at the bottom of sewer or fastened to the walls of a sewer or other channel, the water tries to enter the open end of the cylindrical tubing. There is simply air in this tube, and as the water tries to enter, the air becomes compressed by the column of water and a pressure is exerted which moves the pen arm of the recorder. Thus the actuating medium is a head of water, the pressure of which is transmitted to a pen that records on a chart, which is turned by clock mechanism.



For a range of 10 feet in fluctuations of water surface this form of recorder will read directly to the nearest tenth of a foot, and half-tenths may be estimated. For a range of 20 feet it reads to two-tenths, and tenths may readily be estimated.

Jenckes Machine Company Expanding

The Jenckes Machine Company has secured large additional contracts, which will involve the employment of several hundred more men. Additional capital has been brought into the business through those interests which are identified with the Canadian Ingersoll Rand Company, another of Sherbrooke's large industries. At a recent meeting of shareholders of the Jenckes Machine Company some changes were made in the personnel of the board, Mr. George Doubleday, of New York, becoming the new president and Mr. E. W. Gilman general manager.

Building Permits for November Show Decrease in Value

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

City.	November, 1917.	November, 1916.	November, 1917, compared with November, 1916. Increase (†). Decrease (*).	
Nova Scotia	**$81,373**	**$121,185**	* **$39,812**	* **$32.35**
Halifax	35,208	99,485	* 64,277	* 64.61
Sydney	46,165	21,700	† 24,465	† 112.74
New Brunswick ...	**26,903**	**19,800**	† **7,103**	† **35.87**
Moncton	18,403	4,800	† 13,603	† 283.40
St. John	8,500	15,000	* 6,500	* 43.33
Quebec	**784,170**	**1,842,705**	* **1,058,535**	* **57.44**
Maisonneuve	1,200	15,550	* 14,350	* 92.28
Montreal	219,355	865,530	* 646,175	* 74.66
Quebec	495,945	783,875	* 287,930	* 36.73
Sherbrooke	53,400	15,450	† 37,950	† 245.63
Three Rivers	12,770	127,100	* 114,330	* 89.95
Westmount	1,500	35,200	* 33,700	* 95.74
Ontario	**971,142**	**1,624,693**	* **653,551**	* **40.23**
Brantford	27,346	9,945	† 17,401	† 174.97
Fort William ...	11,100	4,225	† 6,875	† 162.72
Guelph	6,515	.....	† 6,515	† .....
Hamilton	153,460	178,920	* 25,460	* 14.23
Kingston	4,247	10,053	* 5,806	* 57.75
Kitchener	11,765	7,710	† 4,055	† 52.59
London	85,010	64,850	† 20,160	† 31.09
Ottawa	104,200	150,575	* 46,375	* 30.80
Peterborough ...	7,235	5,040	† 2,195	† 30.34
Port Arthur	5,932	3,454	† 2,478	† 71.74
Stratford	6,060	6,485	* 425	* 6.55
St. Catharines ...	56,448	54,470	† 1,978	† 3.63
St. Thomas	2,400	10,890	* 8,490	* 77.96
Toronto	418,019	948,026	* 530,007	* 55.81
Windsor	71,405	170,050	* 98,645	* 58.01
Manitoba	**49,300**	**209,900**	* **160,600**	* **76.51**
Brandon	2,700	16,500	* 13,800	* 83.64
Winnipeg	46,600	193,400	* 146,800	* 75.96
Saskatchewan	**109,290**	**15,580**	† **93,710**	† **601.48**
Moose Jaw	33,950	6,050	† 27,900	† 461.16
Regina	13,240	4,720	† 8,520	† 180.51
Saskatoon	62,100	4,810	† 57,290	† 1191.06
Alberta	**83,700**	**72,700**	† **11,000**	† **15.13**
Calgary	27,700	38,400	* 10,700	* 27.86
Edmonton	56,000	34,300	† 21,700	† 64.15
British Columbia ..	**43,345**	**129,295**	* **85,950**	* **66.43**
New Westminster	4,550	4,725	* 175	* 3.49
Vancouver	35,075	100,695	* 65,620	* 65.16
Victoria	3,720	23,875	* 20,155	* 84.42
Total, 35 cities ..	$2,149,223	$4,035,858	*$1,886,635	* 46.76

Publication Received

"Rules and Regulations of War Trade Board," published by the War Trade Board, Washington, containing official information for shippers, exporters, importers, and commercial and trade organizations.

$2,000,000 Business Machine Corporation

A $2,000,000 corporation has been formed to take over and operate the business and Canadian plants of the International Time Recorder Company, Ltd., the Dayton Computing Scale Company, Ltd., and the Hollerith Tabulating Machine Company, of Montreal. The new company will be known as the International Business Machines Company, Ltd. All business will in future be operated under one central management in Toronto, but the branch offices of each company will be continued under central direction in every important city in Canada. It is the company's intention, in addition to catering to domestic business, to develop an export trade with Australia, New Zealand, South Africa, and South America.

During 1916 the value of municipal water and sewerage plants in the Province of Quebec declined from $52,482,337 to $48,122,253. Municipalities, however, increased their holdings in electric light plants from $2,867,081 to $4,105,001. In the same period new mills and factories erected in the province totalled $6,327,180, as compared with $974,784 in the previous year.

Convention of Canadian National Clay Products Association

THE Canadian National Clay Products Association will hold their sixteenth annual convention at the Prince George Hotel, Toronto, on Tuesday, Wednesday, and Thursday, January 29, 30, and 31. The following is a list of papers and addresses to be given at this convention:

"The Workings of the Workmen's Compensation Act and How Assessments Are Determined for the Different Classes," by Samuel Price, chairman of the Workmen's Compensation Board of Ontario, Toronto.

"The Relation of the Economic Geologist to the Clay Industry," by N. B. Davis, B.Sc., M.A., Kingston.

"Kiln Konstruction Kinks," by W. G. Worcester, secretary of the Alberta Clay Products Manufacturers' Association.

"Burning by the Use of Forced Draft and Low Grade Fuel," by W. G. Worcester.

"Features of Construction of a Big Brick Factory," by A. F. Greaves-Walker, ceramic engineer of the American Refractories Company, Baltimore, Md.

"Manufacture of Floor and Wall Tile," by James McCabe, ceramic engineer of the Frontenac Floor and Tile Company, Kingston.

"Producer Gas-fired Dryers," by R. H. McElroy, International Clay Machinery Company, Dayton, Ohio, based on experiments by Professors Parmalee and Hursh, at the University of Illinois.

"Tile," by Professor W. H. Day, B.A., Ontario Agricultural College, Guelph.

"Motor Trucks in the Brick Business," by Angus German, manager Sun Brick Company, Toronto.

It is expected also that Joseph Keele, chief engineer Ceramic Branch, Department of Mines, Ottawa, and C. W. Price, field secretary of the National Safety Council, Chicago, will be present and take part in the convention.

A message from New York states that the American International Shipbuilding Corporation has placed two large contracts for fabricating structural steel, to be used in building cargo boats for the Government, with the Dominion Bridge Company, Lachine. The orders amount to 40,000 tons of steel plates and shapes.

Personals

Mr. W. D. Cowan, the newly-elected Union candidate for Regina, is an associate of the Saskatchewan branch of the Canadian Society of Civil Engineers.

The following Canadians have been elected associate members of the Institution of Civil Engineers: Lieut. John Cummings, Canadian railway troops; Lieut. Jas. Boyd MacLavhlan, 1st Canadian Heavy Battery, France.

Captain Everall, a returned officer, who was in France for over two years, has been appointed assistant engineer with the Dominion Public Works Department at Victoria. Prior to joining the army, he was engineer for the Dominion department at Port Arthur, Ont.

Captain R. J. Durley, M.E., M.C.S.C.E., Montreal, has been made a member of the Order of the British Empire. Captain Durley, who is by profession a consulting engineer, specializing in heating and ventilation, holds a position in Ottawa under the Imperial Munitions Board.

Major A. G. Tweedie has been appointed city engineer of Sault Ste. Marie, Ont., taking the place of Mr. W. L. McFaul, who has joined the military forces. Major Tweedie has returned from France after eighteen months in the trenches. He is a fully qualified civil engineer of fifteen years standing and has his Bachelor of Science degree from the University of Edinburgh, Scotland.

Lieut. John S. Galbraith, who has won the Military Cross, is a 1913 graduate of the Faculty of Applied Science and Engineering, University of Torono. He was first attached as adjutant to the 123rd Battalion, and in April, 1917, after having served as instructor with the Engineers at Valcartier Camp, he crossed to England, finally reaching France with the Pioneers. Lieut. Galbraith is a son of the late dean of the Faculty of Applied Science, and previous to his enlistment was on the faculty staff.

Mainly Constructional

East and West—From Coast to Coast

The Alberta Flour Mills have taken out a permit in the city of Calgary, Alta., for the erection of a $500,000 building.

The Military Hospitals Commission have all plans ready to construct within 90 days a 600-bed military hospital in London, Ont.

The by-law submitted to the ratepayers of Mimico, Ont., to appoint a commission to take over the public utilities, the waterworks, and the Hydro has carried by a large majority.

It is reported that the T. Eaton Company will go ahead with the construction of their new mail order building on Harbor Square, Toronto, this spring. Plans have been prepared for a $1,000,000 structure, 200 x 400 feet in dimensions.

The Structural Steel Company, Limited, has recently been incorporated with a capital of $5,000, and headquarters at Montreal, to carry on the business of bridge building and engage in the erection of steel and iron structural work of every description.

The receiving depot of the Military Hospitals Commission, on Pier 2, at Halifax, which was badly damaged in the great explosion, has been repaired, and is now ready to receive the ships from overseas bearing the invalids and disabled men back to Canada.

The Standard Engineering Company, Limited, has been incorporated with a capital of $10,000, headquarters at Vancouver, B.C. The new firm will carry on a general contracting and engineering business, both electric, hydro-electric, and otherwise, and act as consulting engineers.

The value of the factories erected in Toronto during the past year was slightly less than in 1916, but there is a considerable increase in the value of the dwellings built. The figures are as follows: 1917—factories, $2,412,765; dwellings, $2,272,345. 1916—factories, $2,486,612; dwellings $1,813,900.

The new school at Stouffville, Ont., built to replace the old building which was destroyed by fire last year, is now almost complete. It contains six rooms and a full-sized basement, and the cost is estimated at about $30,000. It is on the site of the old structure, but additional land has been acquired.

The water board of the Greater Winnipeg Water District will require $4,000,000 for its work during 1918, and Mayor Davidson and the commissioners of the district will go to Ottawa in order to obtain governmental sanction for the issue of the necessary debentures. The following year $2,000,000 will probably be required.

The total of the building permits issued in Chatham, Ont., during 1917 amounts to $390,997. This is a considerable decrease from the previous year, but it is due to the fact that in

December, 1916, the Dominion Sugar Company took out a permit of $1,000,000 for their new factory. Exclusive of this large permit the 1917 total exceeds the 1916 total by $52,073.

After the war it is planned to erect a "Union Building" at Queen's University, Kingston, as a memorial to the students of the college who have been killed in action. The project, which has not yet been definitely shaped, carries with it an endowment of a million dollars, which would be sufficient to erect and equip the building. The idea is that it should be a kind of club house for students.

The Dominion Government, through Hon. C. C. Ballantyne, Minister of Marine, has intimated that about $60,000,000 per annum will be expended on shipbuilding. It is not the present intention to establish new shipyards, but to utilize those now in operation to full capacity. Rolling mills are to be erected for the production of ship-plates, in conjunction with the steel plants now at Sydney, N.S., New Glasgow, N.S., Hamilton and Sault Ste. Marie, Ont.

The announcement has been made in Toronto building circles that Marcus Loew will build a second theatre in Toronto during 1918. The site is said to be Bloor Street near Yonge Stree. The new house will cost $200,000. The architect is Mr. Thomas Lamb, 644 Eighth Avenue, New York. The Loew syndicate opened its latest Canadian theatre at Hamilton recently, and a million-dollar vaudeville house was opened some time ago in Montreal by the same interests. Loew theatres are also in prospect for Ottawa and London, it is declared.

The Halifax reconstruction committee has accepted plans prepared by the Commision of Conservation for terrace-cottage types of dwellings for temporary homes for 1,500 families in that city. This matter has involved great difficulty owing to the combined necessity for rapid and cheap construction and good sanitary arrangements in the temporary dwellings. The first scheme proposed involved the placing of groups of two families in tenements. Mr. Thomas Adams, however, recommended the cottage type of residence, and submitted plans to the reconstruction committee.

If the projects at present tentatively discussed materialize during the coming year, it appears that Regina's 1918 building program will exceed a million dollars. The following are buildings which it is said will probably be built this season: G.T.P. hotel, $500,000; T. Eaton warehouse, $200,000; Roman Catholic college, $200,000; increase of accommodation at exhibition grounds, $100,000; (laundry, $30,000; public comfort station, $15,000; garages and other buildings contemplated, at least $100,000). The construction of the new Pantages theatre, on the corner of Broad and Eleventh, at a cost of approximately $60,000, has been commenced.

The first concrete ship has made a round trip and sailed into its home port, after a successful voyage. It is a Norwegian vessel, called the Nansenfjord, and has just returned from the British Isles, after having steamed two thousand miles. This ship was built several months ago, and is made of structural steel and concrete. It is said to have answered every test satisfactorily, unaffected by the vibration of the engines and withstanding the jamming which a ship frequently receives when it is docked. Also it shows no ill-effects caused by contraction and expansion. The vessel is of the single-screw type, driven by a heavy oil engine, and has a displacement of about five hundred tons.

Up till the time of the explosion, 1917 had been a banner year for the city of Halifax. Business had been flourishing and the shipping tonnage had been abnormal, totalling 15,552,836 up to the close of November. This places Halifax as the third port on the Atlantic seaboard in respect of tonnage. Building, also, had been satisfactory. The permits for the year amounted to a value of $830,850. This shows a considerable decrease from last year's total of $1,167,809, but there was a considerable quantity of government work not included. There was the big hospital at Camp Hill, also warehouses for government occupation, etc., and these would have boosted the figures considerably.

An extensive good roads scheme has been adopted by Yorks County, Ont., having received the approval of the Ontario Government. Over 100 miles of improved highway have already been constructed under the supervision of Mr. E. A. James, chief engineer of the York County Highways Commission, and when the new plan has been completed the county will have 245 miles of good roads. This rounds out the system adopted in 1911 The various sections added are as follows: Kingston Road from Highland Creek to Pickering town line, 1¾ miles (this section must be completed during 1918) Vaughan Road, from Maple north to King City, 2½ miles; Weston Road, from Kleinburg to Nobleton, 3¾ miles; Malton Road, from Scarlet Road to Weston Road, ⅝ mile; extension of Weston Road from Black Creek Hill to the city limits. In Etobicoke Township, O'Connor's Road, the first road east of the Etobicoke, has been added to join the Lake Shore Road and Dundas Street, thus giving an alternative entrance to the city for the Toronto-Hamilton highway traffic. A new road, called the York Road, has also been included, running through Agincourt, O'Sullivan's, Lansing, and Elia, thus forming a belt with the Vaughan Road, Yonge Street, the Don Road, and the Kennedy Road. This is the first cross-road that has been added to the system.

Obituary

Mr. Robert Gash, of London, Ont., a retired contractor, died recently, as a result of a fall from a tree at his home in that city.

Mr. Reuben Bowman, for many years one of the best-known contractors of Kitchener, Ont., passed away recently at his home in that city. Mr. Bowman was born in Kitchener sixty-five years ago and had always resided there. For the past ten years he had been living retired.

Mr. William Earle, C.E., died recently in St. John, N.B. The late Mr. Earle was former manager of the St. John street railway, and latterly was district engineer for the Dominion Government Department of Public Works in Manitoba. He had also done some engineering work for the C.P.R.

Mr. W. E. Soeder, a well-known contractor, of Stratford, Ont. recently met his death by a fall from a defective scaffold at the G.T.R. shops. Mr. Soeder was 30 years of age and a native of Ellice Township. He was an active member of the Stratford Builders' Exchange; also a member of the I.O.O.F.

Mr. Robert Clohecy, one of Hamilton's foremost architects, died suddenly on January 3 from heart trouble. The deceased had been born in Hamilton seventy-nine years ago, and had spent practically his whole life in that city. He designed many of its important buildings, including all the Roman Catholic churches with the exception of the Cathedral and St. Patrick's; also the House of Providence at Dundas, St. Joseph's Convent on Park Street North, and several of the Roman Catholic schools.

Captain William J. Wilson, a graduate in civil engineering of McGill University, is reported killed in action. Before enlistment he was connected with the Toronto Harbor Commission. Captain Wilson went overseas with the 74th Battalion, in March 1916, as a lieutenant, and was attached to the 2nd Canadian Mounted Rifles, with which unit he participated in the actions on the Somme, Courcelette, Vimy Ridge, and Passchendaele. He won his captaincy on the field, and for some months had been acting major in command of a company.

Tenders and For Sale Department

TENDER

Sealed tenders, marked "Tender for Road Construction," will be received by Adrian I. MacDonnell, County Clerk, Cornwall, Ont., until noon, **Monday, January 21st, 1918**, for the construction of approximately 60 miles of County Road.

Tenders may be submitted on sections of five miles or more, each tender to be accomplished by a cash deposit or marked cheque equal to five per cent. of the tendered price.

Plans, profiles and specifications may be seen and forms of tender obtained at the office of J. G. Cameron, C.E., County Road Superintendent, Finch, Ont.

The lowest or any tender not necessarily accepted.

(Signed) ELI MERKLEY,
Chairman Road Committee,
Iroquois, Ont.

51-2

Sealed tenders addressed to the undersigned, and endorsed "Tender for Purchase of Materials in Temporary Bridge at Kingston, Ont.," will be received at this office until 4 p.m., on **Monday, January 28, 1918**, for the purchase of all materials comprised in temporary bridge over the Cataraqui River, at Kingston, Ont.

Forms of tender can be obtained at this Department and at the office of the District Engineers at Equity Building, Toronto, and on application to the Postmaster at Kingston, Ont.

The party whose tender is accepted must make cash payment before the materials are removed.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for $200, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the highest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 28, 1917.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 2-2

POSITIONS WANTED

TO ARCHITECTS, ENGINEERS, CONTRACTORS—Energetic, practical man with fifteen years' experience in building construction, wishes position as Estimator or Superintendent. Box 660, Contract Record, Toronto. 2-2

MAN WITH EXPERIENCE in building construction and knowledge of lumber and all kinds of building material wishes position as salesman. Understands plans and can take off quantities. Box 661, Contract Record, Toronto 2-2

Late News

Chipman, Alta.
Plans and specifications with the secretary-treasurer, P. J. Glanzer, who will receive tenders until January 24 for the erection of a public school for the Hilliard School District No. 3546.

Halifax, N.S.
City let contract rebuilding sewerage system, layout of streets, docks, piers, etc. to H. P. Starrett Corp., 115 Broadway, New York City.

Hamilton, Ont.
Plans and specifications with the architect, F. W. Warren, Bank of Hamilton Building, who will receive tenders until January 19 for alterations, costing $10,000, to store on King St. E.

Montreal, Que.
Bank of Hochelaga, 112 St. James St., contemplate alterations, costing $7,500, to stores. Manager, F. G. Leduc.

Regina, Sask.
Tenders received by the architects, Woodman & Cubbidge, 302 Lindsay Building, Winnipeg, for the erection of a $200,000 reinforced concrete and brick warehouse for the T. Eaton Company, Ltd., 190 Yonge St., Toronto.

Three Rivers, Que.
The Canada Iron Foundries, Ltd., St. Maurice St., contemplate the purchase of a 16-ton crane elevator and the erection of a $50.000 frame and brick extension to their plant. Superintendent, Douglas J. Peake.

Toronto, Ont.
Tenders received by the architect, W. G. Hunt, 17 Queen E., until January 19 for all trades in connection with the erection of apartments, costing $25,000.

Vancouver, B.C.
Vancouver and Districts Joint Sewerage and Drainage Board let contract for cement, steel, and brick sewer to Evans, Coleman & Evans' Ltd., Fort Columbia, at a cost of $35,000.

Victoria, B.C.
The City Council will call tenders shortly for the supply of 60,000 fir paving blocks (untreated). Engineer, Chas. H. Rust.

Westmount, Que.
Block of residences, Metcalfe Street, owned by Geo. M. Martin, J. A. Cameron, W. J. Heller, Wm. Bryce and G. H. Hulm. Loss about $15,000.

Miscellaneous

Meteghan River, N.S.
Siffroi Robichan requires spruce, pine, Douglas fir, hardwood, iron knees and bars, etc., in connection with shipbuilding.

Montreal, Que.
Ross & MacDonald, 1 Belmont St., are preparing plans for a Y. M. C. A. hut for the Young Men's Christian Association, 127 Drummond St.

The Canadian Pacific Telegraph Co., 4 Hospital St., will purchase a motor generator (Lundell)-25 volts, 60 amperes. Superintendent, W. D. Neil, 4 Hospital Street.

Nanoose Bay, B.C.
Powder plant, etc., owned by the Giant Powder Company damaged by explosion. Will rebuild at once. Superintendent, J. B. Turner.

Ottawa, Ont.
By-law in connection with the establishing of a coal yard at a cost of $300,000 has been carried. Clerk, W. H. Lett.

Stayner, Ont.
John Knox wants prices on one 30-h.p. and one 3-h.p., 220 volt, 60 cycle, 3 phase A.C. motors.

Sydney, N.S.
The Sydney Foundry & Machine Co. contemplate steel shipbuilding operations.

Three Rivers, Que.
G. C. Bastien, Civil Engineer, 174 Notre Dame St., wants prices on a few thousand feet of wooden pipe 6 inches in diameter.

Toronto, Ont.
J. W. Devitt, 92 Albany Ave., wants a three-ton endless chain pulley about 20 feet long.

Woodstock, Ont.
City Council contemplate the purchase of motor fire truck and hose. Engineer, F. J. Ure.

Yorkton, Sask.
A. M. McNichol, Box 526, is in the market for one 250-gallon vertical centrifugal submerged pump and one vertical 40-h.p., A.C., 3 phase, 60 cycle, 550 volts, direct drive motor.

CONTRACTS AWARDED

North Vancouver, B.C.
The Lyall Shipbuilding Co., Fell St., have recevied contract for construction of a number of ships, approximate 66,000 tons.

Toronto, Ont.
The following contracts have been awarded in connection with the erection of hog pens costing $50,000 for the Union Stock Yards Co., Keele Street:—General contract, Archibald & Holmes, Excelsior Life Bldg.; roofing, Maitland Roofing Co., 29 Colborne St.; glass, Pilkington Bros., 19 Mercer St.

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The Acute Coal Situation

THE acute situation regarding the coal supply at various points throughout Canada during the past few weeks adds timeliness to a strong article by Mr. Arthur V. White, consulting engineer to the Commission of Conservation, which appears in the annual number of the Monetary Times, under the heading, "Coal Problem of Canada Demands National Action." Mr. White points out that the supply of coal is far from being inexhaustible in the United States, and that we may naturally expect to be obliged in the near future to depend on our own resources. In other words, the temporary crisis of the past month will become a permanent condition, the solution of which must rest with ourselves. In that sense our troubles might prove to have been a blessing in disguise if they succeed in impressing upon us the necessity of getting ready for that inevitable event of which we can now, from our recent experience, form some reasonable estimate.

As a substitute for United States coal, which, in all human probability, we shall lose, Canada has two considerable resources—soft coal and water-power. Canada may, indeed, claim to be well supplied with coal, but, unfortunately, it is of a quality not suitable, in its natural state, for shipment across the continent. One of the big problems before us, then, is to discover some means of economically utilizing this vast resource; it may be by transforming our coal into more stable form so that it will stand shipment, or it may be by converting it at the mines into electric energy and transmitting the power in this form. The latter alternative, however, awaits developments in the electric industry that we may not see in the near future. The former is said to be an accomplished fact, but very expensive in operation.

The other substitute—water-power—Canada also possesses in considerable degree; Mr. White says roughly 20,000,000 horse-power. Much of this, however, is located so far from our more thickly populated areas that it is, temporarily at least, without value to us. That is all the more reason why we should guard with the greatest care the small fraction of the total found within our useful areas. The better located a water-power is, the more reason why its control should be guarded, and also the more vigilance required in properly guarding it, as, naturally, control of such power would be more eagerly sought in proportion as its availability increases.

One does not realize the vast heritage with which the people of Eastern Ontario, for example, have been endowed, by simply gazing on the St. Lawrence River. Figures change the viewpoint, however. Let us suppose that the Long Sault is capable of developing 500,000 horse-power continuously. Roughly speaking, it requires ten tons of coal to provide one horse-power year. Thus the power of the Long Sault Rapids is the equivalent to the Province of Ontario of 5,000,000 tons of coal per annum for all time. The total import of anthracite in 1916 was 4,570,815. Therefore, a proper guarding of our Long Sault heritage alone will take care of the situation when the United States finds it necessary to withhold her anthracite for her own people's use.

How soon that may be is problematical. Our neighbors to the south have been tremendously "white" during the crisis just passed, but let us not forgot that their resources are limited, and that charity begins at home. The necessity to withhold export to Canada may arise sooner than they, or we, expect.

For a permanent crisis, such as we have just had a taste of, and which may come to-morrow, shall the people of Canada not do well to hold themselves in readiness, so far as is humanly possible, by conserving for our own people the heritage Providence has willed us?

Infringing on Rights of Civil Engineers

A BILL promoted in the Quebec Legislature by the Quebec and Atlantic Railway Company, seeking a charter, contains one clause which appears to infringe on the rights of civil engineers, and to be contrary to Act 2, Edward VII., Cap. 25, which defines the qualifications of persons acting as civil engineers in the province.

The Quebec and Atlantic Railway Company propose to take some very wide powers, including those enabling them to carry on business as lumber dealers, agriculturists, owners of water-powers, wool, cotton, and paper manufacturers, miners, and smelters, and so on. The clause, however, which may be regarded as very objectionable from the engineers' point of view is D., Art. 8. This gives power to erect and operate blast furnaces, plants for the manufacture of Bessemer and open-hearth steel, electric furnaces, steel plants, rolling mills, foundries, plants for the construction of steel bridges and machinery; also to act as engineer and contractor for the construction of iron and steel bridges, railways, highways, steamboats, cars, and for the manufacture of steel and iron productions of all kinds.

Now, the Act referred to above is very explicit in defining who shall practise as civil engineers. It says: "The expression civil engineer means any one who acts or practises as an engineer in advising on, in making measurements for, or in laying out, designing, or supervising the construction of railways, metallic bridges, wooden bridges, the cost of which exceeds $600; public highways requiring engineering knowledge and experience, roads, canals, harbors, river improvements, lighthouses, and hydraulic, municipal, electrical, mechanical, or other engineering works, not including government colonization roads or ordinary roads in rural municipalities; but it is not deemed to apply to a mere skilled artisan or workman."

It is further provided that no person shall be entitled in the Province of Quebec to use the title of civil engineer, or any abbreviation thereof, or any name, title, or description implying that he is a corporate member of the Canadian Society of Civil Engineers, nor to act or practise as a civil engineer within the meaning of the Act, unless he is a member of the society, or was practising as such before the Act came into force.

The whole effect of the Act is to enable eligible persons in their individual capacity to become members of the society, and the seeking of powers to practise as engineers by such concerns as the Quebec and Atlantic Railway Company appears to be contrary to the Act quoted above. Companies, in short, are not allowed to practise as engineers.

Ontario Road Superintendents Will Meet

THE fourth annual conference on road construction for county road superintendents and engineers of Ontario will be held at the Parliament Buildings, Toronto, on February 25-28. These conferences have been arranged with a view to enabling the road builders of the province to meet and discuss the many phases of highway construction and to afford the engineers of the Department of Public Highways an opportunity of becoming familiar with conditions in the counties and townships. Such co-ordination between the department and the county and township road authorities is desirable, in order to develop a uniformity of methods and organizations throughout the province, as demanded by the promulgation of a general scheme of improvement.

This year's conference will differ from past ones by having some of the subjects placed before the meeting by the superintendents and county engineers rather than by the engineers of the department.

The program includes the following topics: Municipal Drainage as Related to Highway Construction, by G. R. Marston, C.E., Simcoe; Gravel Road Construction in Middlesex County, by C. Talbot, London; Ontario Highway Laws, by W. A. McLean, Mem.Can. Soc.C.E., Toronto; Legal and Engineering Features of the Elimination of Grade Crossings, by E. R. Blackwell, C.E., M.Can.Soc.C.E., Brockville; Better Bridges and Culverts, by A. Sedgewick, Toronto, assistant engineer, Department of Public Highways; Bituminous Surfaces in York County, by E. A. James, C.E., M. Can.Soc.C.E., Toronto; Heavy Grading of Earth Roads in Lincoln County, by P. Robertson, Beamsville; Preliminary Work on Provincial Highways, by George Hogarth, O.L.S., A.M.Can.Soc.C.E., Toronto, engineer of highways, Department of Public Highways; Clay Road Maintenance in Essex County, by J. F. Millen, Sandwich; Asphaltic Concrete Construction on Dundas Street, York County, by R. C. Muir, Toronto, assistant engineer, Department of Public Highways; Macadam Road Construction in Frontenac County, by R. H. Fair, Kingston; County and Township Road Organizations, by W. Huber, Toronto, assistant engineer, Department of Public Highways; Concrete Road Construction, by T. Harry Jones, B.A. Sc., city engineer, Brantford.

The sixteenth annual meeting of the Ontario Good Roads Association will be held in Toronto on February 27, 28, and March 1. As the last session of the conference will be held on Thursday morning, February 28, and the meeting of the association commences on Wednesday, the 27th, it will be possible for the superintendents to attend the last three sessions of the Good Roads Association meeting.

Coal Production in Canada

ACCORDING to a recently issued report of the Department of Mines, the production of coal during 1916 was 14,483,395 tons, valued at $38,817,481, or an average of $2.68 per ton, as compared with a production in 1915 of 13,267,023 tons, valued at $32,111,182, or an average of $2.42 per ton, and a production in 1914 of 13,637,529 tons, valued at $33,471,801, or an average of $2.45 per ton. Compared with 1915 the production in 1916 shows an increase of 1,216,372 tons, or about 9.2 per cent.

While exceeding the production of each of the two preceding years, that of 1916 was less than the production attained in 1912 and in 1913.

The average number of men employed during 1916 was 23,611 and total wages paid $20,884,236, as compared with an average of 24,574 men employed in 1915 and $17,385,200 paid in wages, and 27,571 men employed during 1914 and $19,060,011 paid in wages.

The total exports of Canadian coal in 1916 were 2,135,359 tons, valued at $7,099,387, as compared with 1,766,543 tons, valued at $5,406,058 in 1915. There is also a small export of coal "not the produce of Canada," amounting in 1916 to 62,783 tons, valued at $150,799.

The total imports of coal in 1916 were 17,580,603 tons, valued at $38,289,666, as compared with imports in 1915 of 12,465,902 tons, valued at $28,345,605.

The total consumption of coal in 1916 was 29,865,856 tons, as compared with 23,906,692 tons in 1915 and 26,852,323 tons in 1914.

Bituminous coal constitutes by far the largest proportion of the annual production. Lignite only is produced in Saskatchewan, and in Alberta it forms a large proportion of the province's production. Of anthracite there is a small output—less than 200,000 tons annually—from one mine, at Bankhead, Alta.

The United States Department of Agriculture has recently issued Bulletin No. 555, entitled "Standard Forms for Specifications, Tests, Reports, and Methods of Sampling for Road Materials."

Two Units of College at Lennoxville, P. Q.

Buildings of Steel Frame and Concrete Construction with Siegwart Beam Floors—Water Supply Derived from 2000 Foot Well

IN our issue of January 3, 1917, we published a preliminary description of the first unit — the preparatory building—of the Lennoxville School, the entire designs for which have been prepared by Mr. Kenneth G. Rea, F.R.I.B.A., Montreal. The school is for preparing pupils for the universities, and is being erected through the generosity of Mr. J. K. L. Ross, of Montreal. The style is Tudor, the buildings being based on the lines of the great English public schools. No money has been spared to make the buildings of the highest class of construction, and nothing has been left undone in the matter of decoration.

The contract for the first unit was let to John Quinlan & Co., Montreal, who have also obtained the contract for the second unit—the dining-hall building. The work now erected consists of the preparatory school, 200 ft. x 64 ft., of four storeys; the dining-hall building, 160 ft. x 56 ft., three storeys; a cloister, 80 ft. long by 10 ft. wide. The power-house erected by G. B. Mitchell, Montreal, is 60 x 60 ft. and 50 ft. high, with a 125 ft. chimney, and contains the boilers, machinery, transformers, etc., and a complete laundry equipment on the upper floor. An underground tunnel leading from the power-house to the buildings has been constructed by the Loomis, Dakin Company, Sherbrooke, who also erected the water-towers. Two miles of sewerage pipes leading to a septic tank and distributing bed have been installed by Charles McNeilly, Ste. Agathe. In addition, 20 teams and 50 men are employed in laying out the grounds, walks, terraces, roads, etc., covering about three-quarters of a square mile. Altogether 250 men are now at work on the buildings, etc., for whom temporary accommodation has been erected, together with warehouses and offices.

Steel Frame, With Siegwart Floors

The preparatory unit affords accommodation for 60 boys, and is divided into two houses, with separate entrances. The building comprises play, music, reading, writing, class, and masters' rooms, besides a large number of dormitories, masters' and matron's bed and sitting-rooms, and sick rooms with nurses' quarters. The superstructure consists of a steel frame, with Seigwart beams and walls of wax-faced brick, and trimmings of Ohio sandstone, with a base of Stanstead granite. The brick is backed with terra cotta. The large corridors and the partitions of the rooms are of Kittanning brick, the floors of terrazzo, trimmed with marble, the lavatories of Missisquoi marble, while marble is also freely employed in some of the rooms for wainscoating.

The dining-hall building has the same general features, as far as materials are concerned, as the preparatory school, with this important exception, that in place of a steel frame, reinforced concrete is employed. The entire basement is laid out for kitchen purposes; thus there is a very large kitchen proper, with the most modern ranges, dressers, etc., refrigeration room, receiving room, stewards' room, matron's and helps' rooms, and heater room. The passages are lined with Kittanning brick, and the rooms have plastered walls and ceilings. The main features of the first floor are the preparatory and the upper school dining-rooms, with a servery in the centre, communicating with both dining-rooms. The servery is to be fitted up with serving tables, and is to be equipped with an elevator running to the kitchen. Small halls are located at either side of the dining-rooms. The preparatory school dining-room has an oak floor, with plaster walls and hung ceiling, while the upper school dining-room has also an oak floor with an oak beam ceiling and plaster walls. The end halls have terrazzo floors, with marble borders and hung plaster ceilings.

The greater part of the second floor is occupied by an assembly hall, 104 x 45.6 ft., having a raised platform at one end. The floor here is of quartered oak; the ceiling has ornamental plaster cornices, and the

Preparatory school building—Lennoxville school.

Dining Hall building—Lennoxville school.

walls are panelled in oak. At either end of the assembly hall there is a small hall, having faced brick walls and marble dados; while on a mezzanine floor there will be located a dressing-room and a storeroom.

There are two entrances, the main one, with suitable mouldings and ornamentation of Cleveland sandstone, and above this there will be leaded glass.

The two buildings are connected by a cloister with five open arches of Ohio sandstone, the floors being of terrazzo, with marble trim.

On the upper portion of the land a well has been sunk to the depth of 2,000 ft., and from there the water is elevated by compressed air into two water-towers, about 60 ft. higher than the elevation of the buildings, so that the water runs by gravity into the various parts of the schools. The pipes, together with those from the power-house, are conveyed in the concrete tunnel, which is 1,000 ft. long, the inside dimensions being 17 x 18 ft.

The general contractors for the preparatory school and dining-hall are John Quinlan & Co., Montreal. Sub-contracts have been let as follows: Structural steel, Dominion Bridge Company; ornamental iron, Dominion Architectural Iron Works; electrical work, Collyer & Brock; plumbing and heating, Thomas O'Connell; marble, Missisquoi Marbles, Ltd.; tile work, James Walker Hardware Company; roofing, ventilation, and metal doors, Macfarlane-Douglass Company, Ltd.; painting and glazing, E. Mapes (preparatory school), and Alexander Craig (dining-room building); elevator, Otis Fensom Elevator Company; refrigeration, Frick Ice and Refrigeration Company; boring of well, Wallace Bell Company, Ltd.; mechanical end of water service, William Perry.

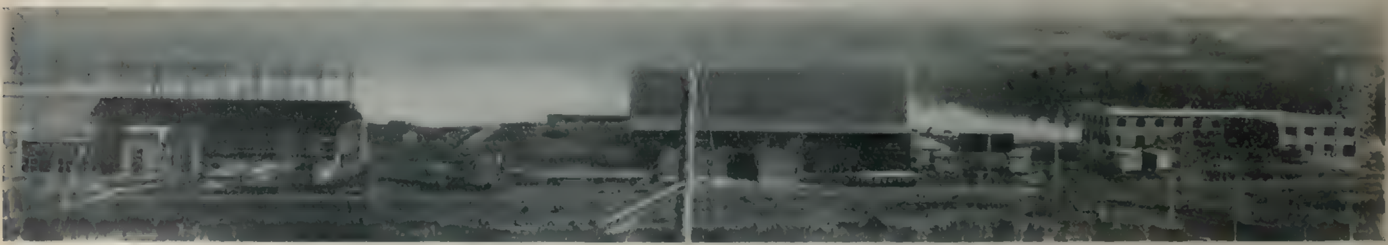
Canadian Aloxite Co.'s Plant

New Development Comprises Series of Buildings, Chiefly of One-Storey Steel-Frame Type—Extensions Provided For

At Shawinigan Falls, P.Q., Church, Ross Company, Ltd., Montreal, are constructing for the Canadan Aloxite Company, Ltd., a series of buildings for the manufacture of aloxite and carborundum. The company is a branch of the Carborundum Company, of Niagara Falls, N.Y., and the plant now nearing completion is similar to that in New York State. Before the work of erection was commenced the land had to be cleared of brush and stumps, while a certain amount of fill had also to be done.

The buildings cover a very large area, and in the main are of one storey, with steel frame and columns. The only structure not of one storey is the maintenance building, with two floors. It comprises a machine shop, general stores, wash and locker rooms for the men, boiler-house, laboratory, and general offices. The building is 166 x 64 ft., constructed of brick, with concrete foundation walls, and concrete floors on the ground floor. The boiler-room also has a reinforced concrete floor. The remainder of the building is of mill construction. The interior partitions are of brick and wood. The floors are supported by wood posts, except in the boiler-room, where they are of concrete.

The aloxite building, 59 x 162 ft., has a steel frame, with asbestos corrugated iron roofing and siding, on



General view of plant development of Canadian Aloxite Company at Shawinigan Falls.

concrete foundations. The floor is of concrete and brick.

The aloxite mixing building is 60 x 162 ft. The foundations are of concrete and the frame of wood, covered with an asbestos corrugated iron.

The carborundum building, on a site 91 x 252 ft., has a steel frame, with an asbestos corrugated iron roof and sides, the foundations being of concrete and the floors of brick.

The plant for carborundum mixing will be in a building 60 x 113 ft., having an extension 16 x 50 ft. The frame is of wood and the roof of asbestos corrugated iron. This section also comprises three large storage bins of laminated wood, on concrete foundations. The bins are for the storage of raw materials; two are 60 ft. in diameter and the other 30 ft. in diameter.

A very complete water system is being installed, including a pumping-house on the river bank. The pumping-house is of concrete and brick, 16 x 16 ft. The water will be pumped from the river and distributed through mains to the various buildings. The entire plant is to be electrically operated, and for this purpose six transformer houses of concrete and brick have been constructed. The company will use about 20,000 horse-power, the greater part being used in connection with the aloxite and carborundum buildings. These latter are to be equipped with electric travelling cranes, running the entire lengths of the buildings, for handling material.

Steel frame of aloxite building.

Two railway sidings have been constructed, each about 800 feet long.

To take care of the employees the company have erected a large kitchen and bunk-house, 30 x 150 ft., in which 90 men will be fed and housed.

The plant has been designed with a view to extensions in the near future.

All the work has been done by the Church, Ross Company, Ltd., with the exception of the electrical portion, which has been carried out by the Aloxite Company. The brick was supplied by the Citadel Brick Company, Quebec, and the National Brick Company of Laprairie, Montreal; drainage tiles and firebricks for boilers by William McNally, Montreal; and cast-iron water mains by the Canada Iron Foundries, Ltd., Montreal.

The steel was supplied by the Hamilton Bridge Works Company, Hamilton, Ont.

Great Activity in Vancouver's Industrial Centre—Descriptions of New Plants

VANCOUVER'S latest industrial centre — Granville Island—is teeming with activity nowadays. On this island, in the heart of the city, already are situated the plants of the Vulcan Iron Works, the Wallace Foundry Company, Ltd., the Pacific White Lead Company, Ltd., the Schaake Machine Company, Ltd., the British Columbia Equipment Company, and the Pacific Dredging Company. Practically all the lots are taken up, and many new industries plan to establish plants during the coming year.

The Vulcan Iron Works, whose plant was completed a few months ago, is already working to full capacity. The shop has an area of 220 ft. by 105 ft., and is designed to handle the heaviest and largest boiler and pipe work. It is of post and beam construction, on pile foundation. All the machinery is on piles. The plant is equipped with four travelling cranes, and has all the latest and most modern machinery installed. It is considered the most up to date (although not the largest) boiler and pipe plant on the Pacific Coast. Gardiner & Mercer, of Vancouver, were the architects, while Hodgson & King were the general contractors, and C. H. E. Williams the electrical contractor.

Shipbuilding Results in Activity

The building of the Wallace Foundry Company is designed as an iron and brass foundry, erected chiefly to look after the large ship and machinery orders which have resulted from Vancouver's growing shipbuilding industry. The building was designed by Gardiner & Mercer, and is the largest and most up-to-date foundry west of Winnipeg. The building has a ground area of 200 x 74 ft., exclusive of the pattern shop and offices, which are housed in a separate building. It is of post and beam construction, and equipped to handle the largest marine castings. It has three large casting pits, ranging from 10 x 10 ft. to 16 x 16 ft., and has three large coke ovens installed. Two cupolas—one three-ton and the other five-ton—are part of the equipment which handles the steel work. The plant has excellent railway and motor facilities, a railway spur coming into the yard close to the cupola loading platform. This plant is also working to capacity, but experiences difficulty in securing competent moulders. Contractors for this plant were Hodgson & King, with Mundy & Rowland contracting for the electrical equipment.

The Pacific White Lead Company have erected on Granville Island a new white lead corroding plant, which they found necessary to meet their increasing export trade. This plant is housed in a building 150 x 75 feet, built of interlocking tile construction, cement rendered on the outside. The floors are also concrete and the roof designed on the Howe-truss principle, so as to retain warmth in the building. Architects, Gardiner & Mercer; general contractors, Hodgson & King; electrical contractors, Cope & Son.

The plant of the Schaake Machine Company, Ltd., which is still in course of erection, is of the post and beam construction, of wood frame. It is designed as a machine shop, and has a floor area of 160 x 65 feet.

Bituminous Surface Treatments for Gravel and Broken Stone Roads

Paper Presented to American Association for Advancement of Science Discussess Efficiency of the Application of Bituminous Materials

By Julius Adler[*]

ABOUT ten years ago the dual problem of dust prevention and road preservation—to borrow the commonly used terms—first assumed importance. A large mileage of hard surfaced roads, which had been built and maintained according to varying ideas and methods, were threatened with destruction; and a variety of bituminous products, differing widely in origin, consistency and behavior, many of which have now disappeared entirely from the market, were applied in the efforts to preserve them. Prior to that time a good macadam road had been defined as one having a smooth, hard surface, furnishing a watertight roof for the earth subgrade beneath, and acting as a "more or less rigid stratum to distribute the concentrated pressure of wheel loads"—in other words, a foundation and wearing surface in one. Under this description, however, were included many roads which were in no wise suited to carry successfully a bituminous surface treatment.

Suitable Surface for Bituminous Material

The present-day macadam road requires at least equal rigidity, and regularity of surface contour has assumed even greater importance; but, in addition, it must meet the special requirement of presenting a suitable surface for the application of a liquid bituminous material. For the latter purpose there is fairly general agreement as to the necssity for a clean Mosaic surface, with a maximum exposed area of tightly locked, coarse road metal and the least possible part of the surface occupied or covered by screenings, dust, or other fine material. If a graded aggregate has been used in the construction or resurfacing of the road it is essential that the distribution of the different sizes shall be uniform, the smaller pieces tending as nearly as possible to assist in locking the larger pieces and to reduce the size of the individual surface voids surrounding them, and that there shall be a complete absence of "pockets" of segregated small sizes. If this result is accomplished successfully the bitumen, after application, will have a direct and approximately uniform anchorage to the surfaces of pieces of solidly embedded road metal, and the gaps between the individual pieces, which must be filled and spanned by the mixture of bituminous material and mineral coverings, will be of the least practicable size. Stated in other words, it may be said that it is now an established fact that the success of bituminous surface treatments is far more dependent upon the condition of the roadway treated than upon the kind of bituminous material used or any other details in the process of application.

Binds and Seals Road Crust

After making reasonable allowance for availability of bituminous materials and for all the differences in the climatic and traffic conditions to which the bituminous surface treated road will be exposed, it appears that a greater and desirable degree of uniformity of practice in connection with this work will be reached only by more careful enquiry into the real purposes of bituminous surface treatments leading to a more general agreement among engineers as to general types, materials, and methods to be employed to meet similar sets of conditions. Bituminous surface treatments at first appear to serve a number of distinct purposes in the preservation of the road surface, but upon analysis these may be placed into two classes—(a) priming and binding the upper portion of the road crust; (b) sealing and smoothing the road surface.

The screenings or fine material occupying the small voids surrounding the coarser pieces of aggregate must be saturated by the bituminous material to a degree that the particles will adhere to one another as well as to the contact surfaces of the adjacent road metal. This should further result in the formation of an irregular, but continuous, waterproofing layer below the road surface, serving to intercept water, drawn by capillary attraction from the subgrade. Contrasted with this, the sealing action consists in the formation of a continuous film of bitumen or bitumen-coated particles coating the exposed surfaces of the upper layer of road metal and filling and bridging the gaps between the individual pieces of the latter with a tough, elastic mixture of mineral covering material and bitumen. This seal coat, so long as it remains intact, serves to waterproof the road surface and tends to produce a generally smooth and slightly resilient surface, lowering tractive resistance, reducing the abrasive and picking action of horse-drawn traffic, and offering more effective resistance to the shearing and displacing action of motor-driven traffic.

Selection of Proper Material

In the selection of the proper material for application to a stone or gravel road these two functions should be weighed according to the necessities of the case. Roads receiving their first treatment undoubtedly require the priming action above described, as the first essential to successful results. Contrary to the practice of some localities, this would seem to limit first application materials to those which are liquid at normal air temperature. The full range of products which can be applied successfully for this purpose is not yet known, but in a given case the selection of the particular material to be used should undoubtedly be influenced by the question of whether the priming coat will be followed by the seal coat within a period of a day, a month, or whether an entire season would elapse. In the latter case it is obvious that a more heavily bodied material would be required than in the first instance. On the other hand, it cannot safely be assumed that all bituminous materials—regardless of character or origin—are necessarily of the same value as primers simply because they are of approximately the same liquid consistency. Observation and experience have taught that there is a considerable difference in behavior in this respect; and, while no specifications as yet attempt to cover definitely this particular point, it has been suggested that a study of the surface tension of different products of about the same consistency be made, since this property bears a direct relation to the height to which a liquid will rise in a capillary tube, which may also be regarded as a measure of its ability to creep down into the irregular capillary tubes formed between the fine particles of mineral matter in a road surface.

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[*] Engineer of tests, Pennsylvania State Highway Department.

Should Not Thicken Too Rapidly

In this same connection it should be remembered that just as the usual "hot application" bituminous material is liquid only so long as its retains its heat, similarly many products which are liquid at normal temperature may remain so only so long as they retain their volatile constituents. If the latter are lost too quickly, the bituminous material will thicken so rapidly as to fail to serve its purpose as a primer. If, as is frequently the case, a bituminous material for first application must serve not only as a primer, but also provide sufficient surface sealing so that the road may safely carry a season's traffic, the most desirable product is that which is so constituted that, while not changing in consistency too rapidly upon exposure to the air, it will nevertheless leave a residue of heavier consistency on the road surface to serve as a cementing material for a partial seal coat.

Considering the second case, if the bituminous material is to serve almost entirely in the production or maintenance of a seal coat, the character of the residual bituminous material finally left on the road surface is the most important factor to be considered. In so far as consistency at the time of application is concerned, the necessity for a material that is liquid at ordinary air temperature is largely removed, since no priming or penetrating qualities are required. There is, however, a greater assurance of a complete union between the old and newly-applied material, and of an enlivening of the former (in the case of roads which have been treated in previous seasons) with the use of this class of material. If a liquid material is to be used for this purpose, it becomes quite important, from the standpoint of the convenience of the traveling public, that it should contain a considerable percentage of volatile material, since a product of the reverse character, placed and held on the surface of a fairly impervious road, creates a slippery and unsafe condition, which requires excessive time for correction because of its slow volatilization.

These considerations indicate that a given liquid bituminous product can hardly be equally suitable for use both as priming and sealing material. Whether a hot or cold application material is used in seal coat, or retreatment work, the essential point is that the original bituminous material, or the final residue from it, shall be of the proper consistency, pliable and elastic, and retain these properties under temperature changes, aging, and exposure to traffic and atmospheric agencies.

Influence of Road Metal on Success of Treatment

The influence of the character or quality of the road metal on the success of bituminous surface treatments is still an uncertain factor. Material of an argillaceous character—that is, argillaceous sandstone or limestone, slates, and argyllite—and bank gravel with a high clay content, have been noted to affect the results adversely. This may be due largely to the usual presence of earthly or shaley material in the screenings used in bonding the road, and again to the smooth, highly polished surfaces of the fragments of some of these varities of rock. Hard, crystalline, metamorphic rocks, of the general character of gneiss, are difficult to bond with their own screenings, and are slow in forming a solid, impervious crust. The road surface frequently ravels in spots under traffic before the first bituminous application is made, thus interfering with the complete success of the treatment. Occasional instances have also been noted of stone so soft as to be crushed by the weight of traffic beneath the bituminous seal, causing a local breaking up of the bituminous seal. In general, however, the requirements for stone for surfaces intended to receive bituminous treatments are less exacting than in the case of waterbound macadam, and a hard limestone may be used with the same bituminous material and under almost as severe traffic conditions, and give as successful results as trap rock.

Surface Treatments Mere Films at First

The completed surface treatment is immediately subjected to the destructive influence of traffic, atmospheric, and climatic agencies. As regards traffic, it is evident that the life and completeness of the bituminous seal depends directly upon the ability of the underlying road crust to furnish complete and uniform support. Surface treatments for at least the first few years of their application can scarcely be regarded as more than films; and, however perfect or elastic this film may be, it is questionable, in view of its small depth and the impact which must be transmitted to the piece of road metal beneath, whether it can reasonably be expected to withstand the pounding of the hoofs and wheels of heavy horse-drawn traffic or the shearing action of heavily-laden solid-tired trucks, especially when acting in the presence of a coating of mud or melting snow or ice on the road surface. In this connection excellent examples of bituminous surface treated roads in suburban sections of cities in which a real estate development unexpectedly begins have been seen to deteriorate rapidly; while, on the other hand, inferior roads in localities where the surface is blanketed with snow or ice, which remains from the early part of the winter to the final spring thaw, are found to be preserved in excellent condition.

It will always be difficult to define the exact localities in which bituminous surface-treated roads can be relied upon to meet all requirements because of the uncertainty of changes in the amount and character of traffic resulting from unexpected developments in industrial operations of all sorts, as well as temporary severe increases resulting from a condition such as previously mentioned. On the other hand, systematically maintained bituminous treated roads have been found to be an entire success under the conditions for which they were originally designed—that is, for large amounts of motor traffic. In an analysis of the cost of such roads in Maryland in 1917, Mr. H. G. Shirley has shown that the annual maintenance cost per mile of bituminous surface treated roads divided by the annual tonnage passing over the road is less for main automobile traffic routes than for any other set of traffic conditions. Experience up to date may be said to have demonstrated that in so far as traffic is concerned the well-built bituminous surface treated road will give satisfactory service in many localities where there is reasonable assurance of a continuance of a preponderance of pneumatic-tired motor traffic with lesser amounts of solid-tired motor and heavy horse-drawn traffic.

As regards climatic conditions, it has already been suggested that roads of this type built and maintained by similar methods apparently encounter the most adverse condition when exposed to a winter climate which includes alternate freezing and thawing coupled with the maintenance of traffic over the road throughout the winter and early spring season; while the reverse condition may act as an actual preservative of a bituminous surface treatment.

All bituminous materials will deteriorate to some degree on exposure to the air and weather. Well-drained macadam road crusts having a complete bituminous seal have been found to contain a very appreciable amount of moisture during the early spring, drawn undoubtedly from the sub-grade and adjacent earth shoulders. This moisture in the body of the road, under freezing temperature, does more damage to bituminous surface films than any other natural agency, especially in the case of roads which, as a result of careless construction, etc., do not conform to some of the requirements previously described. As a further illustration of the importance of frost action, it is reported that in extreme southern states it is possible to maintain bituminous treated gravel roads as a permanent form of construction, in so far, of course, as this type can be called permanent; while in certain New England states, even with careful attention to drainage, it is found impossible to hold the impervious bituminous surface on gravel roads subjected to the heaving and consequent settling of the spring breakup. There is no assurance, of course, that the gravel in the two cases is of equal quality, but all indications point to this as an illustration of the limitations imposed by climatic conditions upon the possible success of this type of construction.

Repeated Applications

Assuming that traffic and climatic conditions are reasonably favorable to this class of work, it still remains to be determined what are its further limitations. Improved methods of construction, more attention to details in the construction of road and better selection and application of bituminous materials, on the one hand, may to some degree widen even its present range of usefulness. Repeated annual treatments, however, introduce problems which are not yet entirely solved. More or less heavy, unstable carpets of bituminous material produced during some of the early stages of this work proved entirely unsuccessful. Successive applications (varying very considerably with the kinds of material used and the nature of the traffic over the road) show indications of producing a similar condition only modified by the facts that the general character of the materials in use is now more suitable than some of the early ones, and that the production of a carpet by a succession of thin layers thoroughly united, and having good adhesion to the surface beneath, is more apt to produce a stable combination. On the other hand, attempts to resurface old macadam roads with bituminous concrete mixtures, even where the mineral aggregate is scientifically graded and the bitumen of selected consistency and quality have been found not to meet with unfailing success and there is apparently no good reason to believe that superior results should be expected from the type of construction under discussion.

From an economic standpoint, it may, under some conditions, be demonstrated that there is a possible saving in the construction, or more frequently the resurfacing, of an existing macadam road, if maintained by systematic surface treatments, as compared to the construction of one of the higher-priced and so-called permanent types of surfaces. Generally speaking, however, it will be found that the combined cost of an annual bituminous treatment with the caretaker or patrol system, totalling from $500 to as high as $1,000 per mile of 16 ft. roadway, represents an annual charge in excess of the maintenance, interest on the difference in first cost, and depreciation on a road of greater initial cost. Consequently, the most apparent recommendation for the bituminous treated road lies in its relatively low first cost, making possible a larger total mileage with the same outlay.

Present hopes for enlarging the field of success and usefulness of this type of work lie in the more careful construction of the original road, more scientific selection of bituminous materials so as best to serve the two functions considered as necessary, and the adoption of systematic and continuous maintenance, so that it may become possible to preserve at least a considerable proportion of these roads in satisfactory condition, with fewer than annual complete retreatments and at a consequent lower annual maintenance cost.

Female Labor Proving Success

Employment of Women Helps to Solve Labor Shortage Problem--Experience of Two Canadian Shops

WOMEN by proving a success in the machine shops of this country have largely solved one labor-shortage problem. In machine and inspection operations, heretofore considered altogether man's work, female labor has shown itself efficient and capable. A large number of the munition shops throughout Canada find places for thousands of women on work requiring both skill and speed. While female operators are, on the whole, proving successful, it is only when vital considerations are recognized that this holds true. Careful attention to various psychological peculiarities of women, for example, is required if the greatest benefit is to be derived from their employment in large numbers. At the recent annual meeting of the American Society of Mechanical Engineers, many manufacturing concerns of this country and the United States reported their experiences, with results generally in favor of women employees. The experience gained by these concerns is typified in a report made by J. W. Upp, of the General Electric Company, Schenectady, N.Y., which is reviewed in the following paragraphs:

Successfully Employed in Electrical Shops

"We have found women, under proper conditions and with proper training, almost, if not quite, the equal of men. We have been much surprised at woman's strength and endurance and are now willing and ready to assign her the duties which were recently assumed to be entirely beyond her ability. She is remarkably quick to learn. We have found, however, that it is necessary to recognize some fundamental difficulties if women are employed in these unusual occupations. In considering her ability to withstand successfully work in the factory, it should be remembered that she is not so strongly built as man, that she is not so tall, that her reach is not so great, that she cannot stand so long, that she is unsuitable for lifting and carrying of heavy weights, and that she must have a great many conveniences which men do not require.

"We had a smaller percentage of failures when our women employees came from the industrial walks of life; that is, from families in which husband, brother or father was a mechanic. The women then understood many of the machine operations. If we drew our prospective employees from those walks of life where the men of the families were engaged as bookkeepers, clerks or in similar work, the women had to receive much more instruction and they were more easily discouraged.

"It has been necessary to supervise and inspect more closely the work turned out by the women than by our regular run of men employees; for few women have any conception of the importance of dimensions or any judgment as to mechanical strength or requirements. You can be sure, however, that once a woman employee is taught how to use a gauge or learns what constitutes satisfactory work, the good work produced in the afternoon will be exactly the same as that produced in the morning. The judgment which is frequently so disastrous on the part of our men employees will not enter into the work of the women operatives.

"Machines must be somewhat more carefully guarded if women are to operate them, than if men were doing the work. In general, safety for women who wear proper shop clothes is provided by the same safeguards as for men, except that with wire guards it is necessary to make the mesh smaller so that the hair cannot get through, and to place guards farther from the moving parts.

"In all classes of factory operations, women are more attentive to their work than men. They are more prompt, observe factory regulations in a better manner, and in general are neater about their work, but we have not been able to impress them with the importance of being on hand every day. Our record of absentees of women is, as a rule, about 20 per cent. greater than among men."

Psychological Peculiarities of Women

There are certain psychological peculiarities of female labor which affect their work and which must be taken into consideration. The temperament of women makes them acutely sensitive to colors, neatness and cleanliness, and harmony in these features must be maintained in the factory and its equipment if it is desired to circumvent discontent. The matter of clothes also calls for careful treatment in order that the clothes-consciousness of women may be successfully abated."

The question of pay is a perplexing problem and one which must be settled locally. The report by Mr. C. B. Lord, of the Wagner Electric Mfg. Co., states: "Woman is not as strong as a man but is more dexterous; she has not the reasoning power of a man, but has a quicker mind. Where either of these attributes adds to her ability she should reap the advantage. Where piece rates are set they should apply equally to both sexes, but when I am asked, 'Should she receive equal hourly compensation with a man?' I must answer, 'No,' but she should receive as much or more than a good-sized boy."

Among the large Canadian concerns that have successfully employed women, are the Ross Rifle Co., in Quebec, and the Canadian Fairbanks-Morse Co., Ltd., Toronto. At the former plant there are three women experts in rifling that set their own machines, grind their own cutters and give an output in quantity and quality as high as expert riflers.

The system in vogue at the Canadian Fairbanks-Morse Company's plant is reported as follows by P. C. Brooks:

Time Schedule at Fairbanks-Morse Plant

"In order to get continuous and sustained effort from the women, we arranged our work on a six-hour continuous basis, which is as long a period of time as anyone can work without stopping to eat or rest. There was no intermission between shifts and there was no general change of shifts at any hour. Each machine had its operating hours designated on the sign over the machine and the four women employees who worked during the 24 hours, knew at what time they were to report to keep this machine going. This scheme was coupled with an arrangement at the time office for a reserve force of women, so that the machines were kept in operation at all times seven days a week

"We gained a large advantage by not having the usual loss of time in a general change of shifts at a given hour. We had women coming in and going out every hour in the twenty-four. We employed about 1,500 under these conditions. Over certain periods the number of women who were discharged or quit was just one-half the percentage of men who left our service under similar conditions.

"Our experience proved to us that we obtained 50 per cent. more general intelligence from women, more punctuality and loyalty, more consistent effort and less trifling, and as to quantity and quality of workmanship, after some experience and under the same conditions, they were fully equal to men in every respect."

Plastic Cement Resists Locomotive Blast

PLASTIC material to protect the undersides of bridge floors from the blasts and gases from the smokestacks of locomotives is being tested on the Atchison, Topeka and Santa Fe Railway, as a substitute for the hard and dense materials usually used for this purpose. The material is Toch Brothers' self-healing bridge cement, which has been used especially for the waterproofing of bridge decks. It gets its name from the fact that if the coating is cut or torn the cut is closed or sealed automatically by the flow or creeping of the cement. It is a viscous material that does not harden. It will not flow in hot weather, and retains its elasticity even at very low tmperatures. A coat of this material is brushed upon the concrete or other surface for a suitable width over the centre of the track. It is not affected by the heat of the exhaust, and sparks and cinders become embedded in it. When this coat is well filled, a second application is made on the rough surface, the operation being repeated until a coating about 1 in. thick has been built up.

Toronto C. S. C. E. Elections

The annual meeting of the Toronto branch of the Canadian Society of Civil Engineers was held on the evening of the 16th, at the Engineers' Club. The officers elected for the year 1918 are as follows: Chairman, Prof. Peter Gillespie; secretary-treasurer, George Hogarth; executive committee, J. R, W. Ambrose, Willis Chapman, E. L. Cousins, Prof. Haultain, E. G. Hewson, R. O. Wynne-Roberts. Committee reports for the past year were submitted at the meeting and the general business of the branch was transacted.

Committee Reports of Canadian Society

Presented at Annual Meeting—Report of Council, Financial Statement and New Steel Highway Bridge Specifications

The annual meeting of the Canadian Society of Civil Engineers is being held this week in Montreal. Probably the most important item to come up for consideration was the change in name to "The Engineering Institute of Canada." Under the new name the scope of this organization will be enlarged so as to embrace all the different sections of the profession—civil, electrical, mechanical, mining, and chemical. From the president's report we quote the following interesting items:

Report of Council for the Year 1917

All recommendations of the Committee on Society Affairs adopted at the last annual meeting have been either carried into effect or are in course of arrangement, the most important item being that a secretary has been secured to devote all his time to the society.

Of the greatest importance to the welfare of the society is the report of the Committee on Society Affairs, presented to council on October 31, embracing a proposed revision of the by-laws and a suggestion to change the name of the society to "The Engineering Institute of Canada." The proposed by-laws were approved by council and submitted to the membership for a vote, as was also done in connection with changing the name, with a view to a final decision being made at the annual meeting.

The suggestion of the president that an executive committee of the council be formed was carried into effect, and this committee, consisting of the president, the local vice-presidents, and the chairmen of the committees of council, handled a large part of the detail, the results of these committee meetings being submitted to council in the form of a series of recommendations from the executive.

Activities of Legislative Committee

A legislative committee was appointed to look after all legislative matters affecting engineers, consisting of three members of council, through whom three members of each branch co-operated. The Legislative Committee's report to council has shown that this departure was an important development in its relation to the society's future.

Having in mind more effective co-operation between headquarters and the branches, the secretary was instructed to visit the Western branches during the summer, and on his return it was decided that he should visit each at least once a year, with a view to being of the greatest possible assistance, the welfare of the branches having been the subject of considerable attention on the part of council during the past year.

The council acknowledges with sincere appreciation the hearty co-operation of the officers of the branches in assisting the Finance Committee in the collection of arrears of dues; and conveys thanks to the Papers and Meetings Committee and the Publications Committee on their activities in having all back transactions and publications of the society issued before the fall session; the Finance Committee for the time and efforts spent in the collection of dues and arrears; and the Board of Examiners and Education for their active support in dealing with the educational requirements of applicants for admission.

The importance of the Maritime Provinces as centres of engineering activity has been considered and the initial steps taken towards the establishing of branches there, it being intended that immediately after the annual meeting the arrangements already instituted will be successfully completed.

Unveiling of Honor Roll

Recognition of the great part members of this society are playing in the world war has been exemplified in the preparation and completion of an honor roll containing eight hundred and fifty-nine (859) names, all of whom have sacrificed much and many of whom have sacrificed all for the world's civilization. The unveiling of this honor roll will be made a prominent feature of the annual meeting. As a further evidence of recognition of the men on the honor roll, council authorized the raising of a tobacco fund to provide a remembrance at Christmas time to each of the men at the front, and the response met with both from the branches and the membership at large showed the keen interest taken in this fund. Tobacco and cigarettes have been sent to all whose addresses are known.

A committee has been appointed to report on a form proposed to be sent to the membership in order to have on file at headquarters a complete and up-to-date record of the professional career of each member, in order that the society may be in a better position to be of service to the individual.

Following the newly-adopted policy of the society to engage in useful public service, the decision of the council to co-operate with the Honorary Advisory Council for Scientific and Industrial Research resulted in the membership at large taking an active part in assisting the Research Council to distribute an industrial questionnaire, the major portion of the detail for Montreal and Quebec being handled from headquarters office.

Fraternal Relations With Other Organizations

The spirit of closer affiliation with other organizations has been exemplified in the invitation from the Institution of Civil Engineers extending to members the use of the institution's library and reading rooms, and a cordial resolution of the Board of Directors of the American Society of Civil Engineers, placing the privileges of their house at the disposal of members of this society and suggesting co-operation and joint meetings to discuss matters of mutual interest. These illustrate the greater fraternity of spirit that is developing in the engineering profession.

The completion of the Quebec Bridge during the past year—erected from designs and constructed under the direction of members of this society, is an achievement worthy of a permanent place in the society's annals, and it is intended to place at headquarters a memorial commemorating this event.

It is with deep regret that council records the death of the late secretary, Professor C. H. McLeod, who for twenty-five years, as secretary and member of council, took a leading part in the direction and development of this organization, and whose sudden passing is a real loss to the society and the engineering profession.

Finances

The financial statement of the secretary showed an excess of receipts over expenditures for the year of $486.70. The Finance Committee also reported as follows:

1. Arrears Collected—In spite of greater exertions, are practically the same as for the two previous years, indicating that most of the cream has been extracted.

2. Current Fees Collected—Shows recovery, in spite of

war and consequent remission of fees to active service members.

3 Entrance Fees—Have increased in a gratifying way over those of other war years.

4. Salaries and Wages—Have been increased, due to the appointment of a permanent secretary and the greater activities of the society during the past year.

5. It will be noted that the branches have secured a considerable increase in rebates.

6. In spite, however, of the absence at the front of over 850 members, whose fees would total about $6,000, and of increased salaries, the society is in a position to show a small excess of receipts, which should increase next year when the effects of new activities become evident.

New Highway Bridge Specifications

The Committee on Steel Bridge Specifications of the Canadian Society of Civil Engineers presented its report embodying general specifications for steel highway bridges. The formulation of these has been under way for some time, and during the past year the discussion regarding them has been continued and a specification for movable bridges added. The specification which has been finally drafted applies to steel highway bridges, including those carrying electric street cars in addition to the regular highway traffic. Bridges for electric railway traffic only, or for traffic which includes heavily-loaded freight cars, are to be designed under the general specification for steel railway bridges. The highway bridge specification has been prepared with a view to their general adoption throughout Canada. Provision is made for four classes of bridges—(a) those in the manufacturing districts of cities and large towns, subject to heavy concentrated loading; (b) those in residential districts of cities and large towns; (c) those on country highways and in small towns and villages; (b) those in remote or mountainous districts difficult of access, and where the first cost is the most important consideration.

In the Contract Record of January 31, 1917, the work of the Committee on Bridge Specifications, up to the time of the last annual meeting, was outlined, and the issue of December 13, 1916, contained comprehensive proposals, drawn up by Mr. Pratley, which were considered in the final draft of the committee.

The World's Largest Simple Truss Bridge

Important Problem in Designing 720 ft. Span was to Keep Weight Down to a Minimum by Special Details and Silicon Steel

THE largest simple truss bridge span in the world is the main channel span of the Ohio River bridge at Metropolis, Ill., U.S.A., which, being 720 ft. in length, exceeds the next largest by 52 ft. The Ohio River is crossed at Metropolis by a 5,700 ft. bridge, comprising trestle and plate girder approaches, one deck truss span and six through truss spans. The length of the main span crossing the channel was determined by the War Department's requirement for a 700 ft. channel width. For such a length the cantilever type of bridge has heretofore been regarded as standard. The engineers of the Chicago, Burlington, and Quincy Railroad, for which company the bridge was built, believed, however, that there were favorable possibilities in a simple truss span providing that steel of higher quality than ordinary 60,000-pound bridge steel was used.

As this is a record-breaking simple truss span, its design naturally constituted an engineering problem of first magnitude. In this case eight 'years' planning formed the background for the final design. The Engineering News-Record gives a sketch of some of the determining ideas in the design of this span, and as the study of these is important to the bridge constructor, the following notes will be of interest:

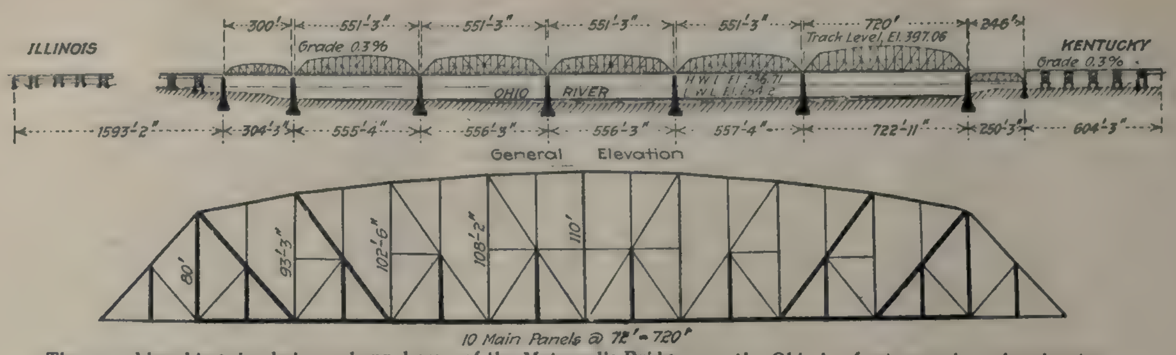
The largest simple truss span in the world.

It has been believed by some that a simple span of this length would be virtually impossible to build of 60,000-pound steel. This is not the case, though the difficulties of design would have been very seriously increased, especially as to sizes of members and joint-packing. The fact remains that special steel was contemplated from the first, on the ground that in this range of magnitude of span it secures economy of total cost by reducing the dead weight to be carried.

Cantilever vs. Simple Span

Several of the engineers advised a cantilever span. Comparison of a simple span with a cantilever design was made, and the latter showed materially lower cost, despite the reduced opportunity for using eyebars. The advantage of safety in erection, by dispensing with falsework, weighed even more heavily in favor of the cantilever. Experienced bridge erectors say that erecting so large a span on falsework in the uncertain flow conditions of the Ohio is inevitably hazardous. The contractors for the bridge were distinctly relieved when, after remarkably rapid and smooth erection, thev closed and swung the big span (last December) with out high-water troubles.

Mr. Cartlidge, chief engineer of the Burlington Railroad, favored the simple-span type strongly. The main consideration was rigidity, but belief in the greater wear-resistance of the simple type may have been an additional factor. The pier caissons of the bridge rest on sand, and there is some reason for thinking that rock foundations would have led to more favor for the cantilever; that possible settlement of the piers



The record-breaking simple-truss channel span of the Metropolis Bridge over the Ohio is of extreme pin-and-eyebar type. Heavy lines in the large diagram indicate eyebars.

was thought likely to derange a cantilever structure more than a simple-span bridge.

Full pin-connected construction was also early decided upon. Large joint connections were thus eliminated and the use of eyebars provided for. Through these features much weight was saved; and in the Metropolis span weight-saving was so vitally important that it dominated the detail design, when once the general elements had been fixed.

With respect to eyebars, all the engineers favored extensive use of eyebars in the span. The superior strength and reliability of the eyebar over other forms of tension member is a decisive advantage, supplemented by great saving of weight in dead metal. The disadvantages of eyebars disappear in a span of this size. Mr. Cartlidge carried the preference for eyebars to unusual limits, however.

After deciding for a simple span, selection of truss type lay between two—the subdivided Pratt truss and the K-truss, both with curved top-chord. The engineers believed the former preferable, but a K-truss design was carried far enough to prove the Pratt truss more advantageous, and therefore the latter was adopted.

Silicon Steel Reduces Weight

The choice of material lay at first between high-carbon steel, Mayari steel, and nickel steel. Later a special steel was offered under the name "silicon steel," a carbon steel with its silicon, carbon, and manganese raised well above ordinary bridge practice. Comparison among these materials involved both cost estimates and strength tests. A set of large-size column tests was made by the Bureau of Standards for the purpose, abstracts of which were published two or three years ago. Allowable unit stresses were determined on the basis of these tests.

Silicon steel received the final preference. A comparison with a design using high-carbon steel in top chord and end posts (and ordinary steel elsewhere) showed the latter design to be considerably heavier. The competition of silicon with Mayari and nickel steels seems to have been decided by price.

The adopted material was at first proposed for the compression members of the trusses only. Eyebars of silicon steel were not offered by the makers; instead, nickel-steel eyebars were proposed and used. For the riveted tension members in the end panels of the bottom chord and the diagonals of the four middle panels (where reversing members were adopted instead of using counters) it was planned to use plain carbon steel. The engineers did not trust the tensile reliability of silicon steel in a riveted member. But their convictions on this point changed later, when it became apparent that the material could be worked without injury (in a certain range of thickness). Consequently, the members in question were made of silicon steel, but subjected to lower unit stresses than the nickel-steel eyebars.

The selected materials made it possible to use a basal unit stress of 25,000 pounds per square inch in tension and 30,000 in compression for the built members of the trusses, and 35,000 in tension for eyebars. As compared with a 20,000-pound unit stress, this increase of 20 per cent. and over decreased the total steel weight of the span by more than 30 per cent., even with ordinary bridge steel in the floor.

Shop Operations on Silicon Steel

Experience in the shop demonstrated that silicon steel could be punched in thicknesses up to ½ in. with no greater effect than in ordinary bridge steel. The early beliefs of both makers and engineers had, however, been opposed to the practice of punching silicon steel, and for this reason throughout the job the holes were drilled from the solid.

For the floor system it was at no time contemplated to use anything but plain bridge steel. The best expression of the reason for this is that, with the uncertainties of a new material opposed to the recognized punishing qualities of carbon steel, it was believed that the latter could not be dispensed with. Additional factors were the desire to have thick metal in the floor members and the striving for maximum rigidity.

Opinions have changed somewhat since the Metropolis bridge was designed, and two bridges are now under way which use silicon steel in the floor as well as in the trusses. In both cases the floor is double-track, just as at Metropolis. Calculations have shown that with long panels and double track the cost of a floor of silicon steel is no greater than the cost of a carbon-steel floor, and the influence of the reduced floor weight on the trusses of a long-span bridge is, therefore, a net gain. This has bearing wherever the considerations above quoted as determinative in the Metropolis case are not held to be decisive.

In developing the outlines of the simple span design the truss depth and the panel length were studied by comparative estimates.

The calculations of weight for different truss depths led to a decrease of the first-chosen depth (120 ft.) to 110 ft. The panel length was increased to 36 ft., after comparison with a panel of about 30 ft., the former showing lower weight. None other than a subdivided web system was in view at any time. The width of bridge (spacing of trusses) was made slightly greater than the traditional specification requirement for width not less than one-twentieth of the span. A spacing of 37 ft. was adopted; earlier, a spacing of 40 ft. had been considered.

To assure long life of bridge, a large future increase of loading was counted on. The train load was assumed at 7,500 pounds per foot of track, and the engine driving-axle loads at 90,000 pounds. These figures represent a margin of at least 25 per cent. over present-day traffic weights. They may be regarded either as regular design loading for normal service stresses or as emergency loading by which to test the design for safety under limiting conditions.

Big Problem Was to Keep Down Weight

The important problem in the detail designing was to hold down the weight to an absolute minimum.

It was Mr. Cartlidge's strong conviction that all the weight economy obtainable by the use of eyebars as tension members should be obtained. In carrying this into effect, even the sub-hangers, which carry the intermediate floorbeams, were detailed as eyebars. The hip vertical is also made an eyebar member, but for erection service it was given some value as a strut by riveting a transverse plate diaphragm longitudinally between the bars.

Most characteristic of the bridge is the use of long (72 ft.) eyebars in the bottom chord. There is no connection between these bars and the floorbeams at the subpanel points, but a simple stirrup at the end of the floorbeam supports the bars. By this arrangement secondary stresses due to distortion of the subpanel triangle under load are eliminated, while at the same time the weight of a pin and two sets of eyebar heads is saved.

The economy secured through use of the eyebars is represented by the sum of 10 to 15 per cent. saving of section in rivet holes and details and 5 to 10 per cent. increase in unit stress allowable in eyebars over built members. Thus, about 25 per cent. of the weight of tension members in the trusses was saved, comparing with built members of nickel-steel, and about 35 to 40 per cent. when comparing with members of silicon steel. Because the eyebars were so important for economy, they were used even where serious difficulty was encountered in making room for the end connections. Diagonal U4-L6 was a case where the substitution of a built member would have simplified the joint details considerably, but eyebars were retained.

Contractors Objected to Eyebars

When the erection problem was worked out by the contractor, the eyebars in the web system and the long bottom-chord eyebars were objected to because of the delay resulting from the awkwardness of handling such long, flexible members. But the engineers adhered to their plans, and, as already stated, the only use of built members in tension is in the diagonals of the four middle panels and the bottom chord in the end main panel.

To save weight of lattice and other detail metal in compression members, the top chord and the posts were detailed of H-section, using a central transverse diaphragm. For example, the middle top-chord member consists of two webs 42 x 1¾ in., four angles 8 x 8 x 1⅛ in., four flats 10 x 13/16 in., and a diaphragm with web 32 x ¾ in., and four angles 6 x 6 x ⅝ in. All of this metal is effective cross-section, and, while top and bottom lattice is also used, it forms a much smaller proportion of weight than would otherwise be needed.

Partly because of the presence of the diaphragm, very thick plates in the side ribs of the top chord were thought permissible—as the 1¾ in. plates just noted. Some difficulty developed in the shop in securing acceptable plates of these dimensions, especially with regard to straightness, or freedom from waviness at the edges. It is now believed to be better practice to use plates not thicker than 1 in. to 1¼ inches.

In the floor occur one or two interesting weight-saving details. There is only one stringer lateral system, between the two centre stringers; occasional struts in the plane of the upper flange extend over to the outer stringers to brace them. There is no traction bracing. Longitudinal forces pass from the stringers into the subpanel floorbeam, and this must transmit them (by bending) to the middle of its length, where the diagonals of the main bottom lateral system are attached to the lower flange. These diagonals clear the lower flanges of the stringers, but are hung from them by stirrups.

Quebec Bridge Designs Discussed at C. S. C. E. Meeting

YET another phase of the design and construction of the Quebec Bridge was dealt with by Mr. George H. Duggan at the meeting of the Canadian Society of Civil Engineers, Montreal, on January 10. Mr. Duggan, chief engineer of the St. Lawrence Bridge Company, spoke on "Tendering Designs of the Quebec Bridge." He first outlined the steps taken to form the board of engineers, to collect data, and to prepare trial designs. The board made the most careful investigations into the engineering features of great bridges in many countries. Mr. Duggan explained in detail the differences in design between the Forth Bridge, the Quebec Bridge which collapsed, the design by Mr. H. E. Vautelet, the ex-chairman of the Quebec Board of Engineers, which was not adopted, the official design ultimately decided on, and the design of the St. Lawrence Bridge Company now carried out. The company made thirteen bids on the official design and on their own, and spent many months working out the details of both plans and investigating the use of nickel and carbon steel before tendering.

Mr. Duggan also pointed out what he considered weak elements in Mr. Vautelet's design and also in the official plan, emphasizing the phases of erection in relation to the travellers proposed to be installed. He showed that, owing to different conditions, it was impossible to adopt the same methods of erection as in the case of the Forth Bridge, and gave reasons for the non-adoption of features in that bridge and in the first Quebec Bridge.

A considerable portion of Mr. Duggan's address was devoted to explanations of why various plans were adhered to, directing special attention to the value of the K truss. He stated that they considered seriously the adoption of the truss in the central span, but found certain difficulties which made it advisable not to use it for that portion of the work. He concluded by an appreciation of the services of various members of the staff of the bridge company.

Clearing Snow from Country Roads

Snow may be removed from roads by using a road-drag in reversed position, so that it will push the snow into the side ditches.

Investigating War Inventions

Procedure of British Munitions Inventions Department in Selecting and Developing Meritorious Ideas

FACILITIES for the investigation of inventions are of prime importance in a time of war. Thousands of ideas directly or indirectly relating to war equipment and its manufacture are being submitted annually to the governments of the warring countries. When it is realized that but a very few of the schemes suggested can ever prove worthy of extended consideration, it is obvious that there must be some well-organized technical department for the investigation of all inventions submitted, so that those of supreme merit may be selected and given more exhaustive tests. In England work of this character is undertaken by the Munitions Inventions Department (M.I.D.), a branch of the Ministry of Munitions. "The Engineer" contains an outline of the organization of this department, which is admirably planned for the work it has to perform.

The M. I. D. has to select from the thousands of inventions submitted annually those that are worth considering at all—not more than 4 or 5 per cent. at most—and of these to eliminate those that prove valueless on further trial. To simulate as far as possible war conditions the department has a special trial ground, and certain liaison officers watch inventions in the field and report upon them to the ministry, so that they may be modified, rejected, or approved, while other officers keep in touch with the work of our French ally, so that there may be frequent exchange of ideas. The M. I. D., according to "The Engineer," has not only given great assistance in the field by the encouragement of useful inventions, but has, in the workshop and in chemical, metallurgical, optical, and many other classes of factories at home, encouraged invention and developed industries in a manner which will only be fully appreciated when the history of its endeavors sees the light.

The Munitions Inventions Department was formed in 1915, with the object of ensuring that any proposal likely to be of service to the state in carrying on land warfare, from whatever source it may emanate, should be fully considered, developed, and experimented with, in order to exploit as far as possible the inventive ingenuity and information placed at the service of the Ministry of Munitions.

The department is constantly in communication with the various branches of the War Office, such as those of the Director of Aircraft Equipment, Quartermaster-General, Director of Fortifications and Works, and the Director-General of the Army Medical Services, and it collaborates with these branches respecting the military technical value of stores for which the branches are responsible. Problems for solution have been presented by these branches from time to time; the personnel and organization of the Munitions Inventions Department is peculiarly adapted to solve such problems and to give the necessary assistance with regard to the provision of new and improved forms of service stores.

Machinery and Procedure

The machinery consists of an honorary advisory panel of scientific, technical, military, and naval experts of the highest reputation. The office staff consists of the comptroller, assistant comptroller, secretary, technical advisers, examiners, military advisers, draughtsmen, and clerical staff.

The general procedure in the treatment of inventions submitted to the department is as follows:

The description, when received, forms the basis of an official file, which is classified and sent to the corresponding examiner. He reports upon the case, and, in conjunction with a military adviser, submits it first of all to a small sub-committee of the main committee of the advisory panel which deals with the particular subject.

The committee of the advisory panel holds periodical meetings—generally once a fortnight—at which all the cases which have been examined since the preceding committee meeting are brought before the committee by the examiner, and a decision is arrived at as to the action to be taken. This, for instance, may be a decision further to develop the invention in the drawing office of the department or to construct models or actual apparatus for trial, as nearly as possible under service conditions, at the experimental ground of the department at Claremont Park, Esher. Those cases which present no features of novelty or practical military utility, or do not bear upon more economical or expeditious production of munitions, are declined by the committee.

Avoiding Controversy

The next stage in the procedure is that a letter conveying the decision of the comptroller is despatched to the inventor. Great care is necessary in conveying an intimation that the invention has been rejected. The inventor is often completely obsessed with his ideas, and cannot tolerate the mere official formal rejection of his proposals, which have probably engrossed his attention for some time, to the exclusion of all other interests. The policy of the department is to ensure that sufficient reason for declining an invention is advanced, while at the same time the decision is so framed that controversy may, if possible, be avoided. With this object in view the letters declining inventions are drawn in such a way as to emphasize those aspects of refusal which are decisive against the invention without making any direct attack upon its merits; at the same time the susceptibilities of the inventor himself are considered. Having regard to the very large numbers of cases considered since the institution of the department—some 35,000—it is satisfactory to point out that the number of inventors who have been thoroughly discontented with the action of the department is relatively very small.

Where further research or experiments are ordered to be carried out by the committee, advantage is taken of the voluntary assistance of many technical and scientific institutions.

The Department and the Inventor

It will be seen from the above notes that the work of the department is of a research character, and that the policy is to give every possible assistance to any inventor submitting a scheme which appears to have even a scintilla of value. The advice of examiners, who are all technically trained men drafted from the Patent Office, and of the military advisers of the department; the facilities of the drawing office and the workshop actually on the premises, together with those which are afforded by the experimental ground at Esher, and the assistance given by various scientific laboratories, are all at the disposal of the inventor, and the department is thus enabled to afford him an amount of technical assistance which it would be very difficult, if not impossible, for him to obtain elsewhere at the present time, even at a very great expense.

Liaison Officers

An attempt is made to keep in touch with problems which arise for solution at the front by means of liaison officers, who pay frequent visits overseas for the purpose of consultation with G. H. Q. in France with a view to collecting information as to matters on which the department might be able to afford valuable assistance. There is also frequent inter-communication between the department and officers arriving in England from G. H. Q. from time to time.

Relations are also maintained with the French Ministry of Munitions by means of an officer of that ministry, who has an office in this department, and attends the meetings of the committee. In addition, a liaison officer attached to the department spends most of his time in France, and keeps in touch with the work that is being done by French inventors, transmits reports, and pays frequent visits to the department to discuss the information that has been placed at his disposal by the French authorities.

Patents and Rewards

There is also attached to the department and housed in the same building a patents and rewards section, which is charged with the duties of:

1. Investigating applications from officers, N. C. O.'s, and men, and of civilians employed under the War Department, for permission to take out patents.

2. Arranging for the taking out of secret patents and the assignment thereof to the Secretary of State for War.

3. Investigating claims for rewards and royalties in respect of inventions that have been adopted in the service of the crown, making recommendations to the War Department as to the payments proposed, and conducting negotiations with inventors.

4. Arranging with the Comptroller of Patents for the prohibition of publication of patents which it is thought desirable to suspend.

5. Dealing with applications from inventors for permission to submit particulars of their inventions to foreign governments.

This section keeps in touch with the Admiralty, and receives and transmits particulars of patents which have been taken out by officers, petty officers, and men of the navy.

Large Scale Operations in Housing

By Leslie H. Allen

UNTIL quite recently small house construction in connection with industrial developments has been entirely in the hands of the local builder, operating on a small scale. During the past year, however, with the institution of several large housing developments in which speed of construction and durability of workmanship were important essentials, large contracting organizations have taken up this class of work, so that the manufacturer can now get the same kind of service in his house construction as he has been accustomed to get in his plant contracts. A good deal of economy is always gained when a large number of houses are built at one time by one contractor. The money saved by purchasing direct from manufacturing firms in carload lots rather than in team-loads from a local dealer, the continuous employment of large gangs of men, the taking of cash discounts and other economies practised by big contracting organizations are quite a help in reducing costs.

When the whole development is under the control of one responsible contractor the disappointments so often experienced of houses built but roads not finished or sewers not completed are avoided. The grade of workmanship is better, and the work is finished promptly instead of being allowed to drag far beyond the scheduled contract time.

Building Permits Are Falling Off

THE value of building permits issued in thirty-five cities, showed a decrease during December as compared with the previous month, the total value of permits falling from $2,149,223 in November, to $874,689 in December, a decrease of $1,274,534, or 59.3 per cent. The only province to record an increase was British Columbia. As compared with the corresponding month of 1916, there was a decrease of 81.6 per cent., the value for December, 1916, being $4,765,313. In this comparison none of the provinces reported increases.

Of the larger cities—Montreal, Toronto, Winnipeg and Vancouver—the last named only showed an increase as compared with November, 1917, while each of the centres recorded a decrease in comparison with December, 1916. Of the smaller cities, Three Rivers, Westmount, Brantford and Kingston showed increases in both cases.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-Five Cities

City	December, 1917	December, 1916	December, 1917, compared with December, 1916	
			Increase(*) Amount	Decrease(†) Per cent.
Nova Scoia	**$24,390**	**$61,020**	**† -$36,630**	**† 60.03**
Halifax	13,255	52,820	† 39,565	† 74.90
Sydney	11,135	8,200	* 2,935	* 35.79
New Brunswick	**2,625**	**18,100**	**† 15,475**	**† 85.50**
Moncton	1,125	16,100	† 14,975	† 93.01
St. John	1,500	2,000	† 500	† 25.00
Quebec	**132,610**	**487,383**	**† 354,773**	**† 72.79**
Maisonneuve	......	......	......	.....
Montreal	56,270	298,000	† 241,730	† 81.12
Quebec	8,440	89,009	† 80,629	† 90.52
Sherbrooke	......	88,500	† 88,500	......
Three Rivers	50,000	3,750	* 46,250	*1233.33
Westmount	17,900	8,064	* 9,836	*121.97
Ontario	**620,485**	**3,809,765**	**†3,189,280**	**† 83.07**
Brantford	149,915	5,735	* 144,180	*2514.04
Fort William	850	1,500	† 650	† 43.33
Guelph	150	43,750	† 43,600	† 99.66
Hamilton	26,450	116,750	† 90,300	† 77.34
Kingston	9,607	2,870	* 6,737	*234.74
Kitchener	......	13,825	† 13,825	......
London	34,590	18,705	* 15,885	* 84.92
Ottawa	11,100	41,125	† 30,025	† 73.01
Peterborough	335	1,025	† 690	† 67.31
Port Arthur	2,740	6,272	† 3,532	† 56.31
Stratford	790	115	* 675	*586.96
St. Catharines	8,215	36,145	† 27,930	† 77.27
St. Thomas	800	4,700	† 3,900	† 82.98
Toronto	370,358	3,428,848	†3,058,490	† 89.11
Windsor	4,585	87,400	† 82,815	† 94.75
Manitoba	**9,600**	**29,205**	**† 19,425**	**† 66.92**
Brandon	......	125	† 125	......
Winnipeg	9,600	28,900	† 19,300	† 66.78
Saskatchewan	**12,534**	**18,380**	**† 5,796**	**† 31.53**
Moose Jaw	800	125	* 675	*540.00
Regina	7,050	2,655	* 4,395	*165.54
Saskatoon	4,734	15,600	† 10,866	† 69.65
Alberta	**10,200**	**29,700**	**† 19,500**	**† 65.66**
Calgary	10,200	9,200	* 1,000	* 10.87
Edmonton	......	20,500	† 20,500	......
British Columbia	**62,195**	**311,940**	**† 249,745**	**† 90.05**
New Westminster	1,600	1,700	† 100	† 5.88
Vancouver	56,295	286,365	† 230,070	† 80.34
Victoria	4,300	23,875	† 19,575	† 81.99
Total—35 cities	**$874,689**	**$4.765,318**	**†$3,890,624**	**† 81.64**

Wide Variety of Topics to be Discussed at Road Builders' Convention

THE program of the eighth American Good Roads Congress, to be held at the Hotel Statler, St. Louis, Mo., February 4 to 7, 1918, under the auspices of the American Road Builders' Association, is in course of preparation, and, up to this time, the following tentative subjects have been selected:

"A Study of the Relative Efficiency of Motor Trucks as Affected by the Length of Haul."

"The Value of Improved Roads for Motor Truck Transportation as Auxiliary to the Railroads."

"Necessity for Uniformity in Motor Truck Legislation."

"Roads in the Hudson River District With Unusual Construction Features."

"The Necessity for the Immediate Development of Commercial Roads That Are of Military and Strategic Advantage."

"Surety Bonds for Highway Purposes."

"A State Highway Department as a Contractor."

"Massachusett's Scheme for Contractors."

"New Features in Design and Construction of Earth, Sand, Clay, Gravel, and Waterbound Macadam Roads and Pavements."

"New Features in Design and Construction of Bituminous Roads and Treatments and Cement Concrete Roads and Pavements."

"New Features in Brick, Wood Block, and Stone Block Pavements."

"New Features in the Maintenance, Reconstruction, and Repair of Earth, Sand, Clay, Gravel, and Waterbound Macadam and Bituminous Roads, Penetration Method."

"New Features in the Maintenance, Reconstruction, and Repair of Bituminous Roads, Mixed Method; Cement Concrete, Wood Block, Brick and Stone Block Pavements."

"How to Lay Out and Justify a War Program for the Building of Roads."

Use of Vibrator on Newly Laid Concrete Pavement Produces Dense Surface

A NEW method of construction for concrete pavements, for which several advantages are claimed, has been experimented with on roads in several parts of the continent. The principle feature of the process is the treatment of the layer of green concrete with gasoline-engine vibrators in order to obtain the densest possible concrete. The machine and the process have been patented, and while it is understood that there are pavements seven years old which have been constructed under this specification, it is within the last year or so that particular attention has been given to the method.

Except that the mix is somewhat drier than usual, specifications and method of construction, up to the time when the concrete has been placed on the roadbed, do not differ from ordinary good practice. Immediately after placing, raking and smoothing the freshly laid concrete to grade, however, a coating of granite or trap rock between 1 in. and 2 in. in size is spread over the surface to a depth of between 1 and 2 inches. Flexible board platforms are then laid on the surface with the boards parallel to the centre line of the pavement. On these platforms the vibrators are rolled. The vibrator machine is merely a 4 h.p. motor-cycle engine mounted on a steel frame with steel roller wheels. The pulsations of this unbalanced engine are about 1,000 per minute.

By using such a machine, the result of the vibration or quaking is, of course, to force the surfacing of broken stone into the concrete and to flush out the surplus water and mortar, thus tending to produce a dense mass and surround the stone, which will be the wearing surface, with a rich, dense mortar.

After the concrete is a day or two old, a high speed revolving broom is passed over the surface to remove laitance and surplus mortar and leave a clean, hard, stony surface. A hot tar carpet is immediately spread on this surface and covered with pea stone or grit. The object of this tar carpet is chiefly to protect the concrete during the curing process by retaining the moisture until a complete set has occurred, and saving the green concrete from the abrasions of traffic. The pavement does not require to be kept dampened or covered with mortar, water or earth as is the usual practice.

The advantages of this process are summed up as follows: The vibrations produce density in the entire mass and permit the economical addition of broken stone in the upper part of the slab and bring to the surface a rich, dense mortar to bind the added stone, while the stone, being at or near the surface, forms the ultimate wearing surface. The seal coat of tar, covered with pea stone or sand, forms the temporary wearing surface, improves the appearance of the pavement, and makes it noiseless, gives it a non-skid surface and aids in uniform curing of the concrete. Pieces actually broken out of old pavements show the stones in close proximity with each other and a smooth, flinty plane of cleavage characteristic of a dense and thoroughly hydrated concrete.

Nominations for Office in Montreal Builders' Exchange

The secretary of the Builders' Exchange, Montreal, has received from the Nomination Committee the following nominations for 1918: President, J. P. Anglin, B.Sc.; first vice-president, Robert F. Dykes; second vice-president, W. M. Irving; past president, John Quinlan; directors, A. Charette, H. Fussing, Fred. B. Locker, W. E. Ramsay, J. J. Roberts, A. Rutherford, Walter Ryan, Charles F. Smallpiece, H. Vincent, J. E. Walsh, A. H. Webster.

Of these Mr. Locker is the representative of the Montreal Mantel and Tile Dealers' Association, and Mr. Ryan the representative of the Master Plumbers' Association of Montreal and vicinity.

Members can still be nominated, provided notice is given to the secretary in writing at least one week before the date of election, January 28, and provided that the nomination is supported by the signatures of at least two members.

Annual Meeting of Ottawa C.S.C.E.

The annual meeting of the Ottawa branch, Canadian Society of Civil Engineers, was held on Thursday, January 10. The following officers were elected by the Managing Committee for the year 1918: Chairman, G. Gordon Gale, vice-president and general manager of the Hull Electric Railway; secretary-treasurer, J. B. Challies, superintendent Dominion Water-Power Branch. The new members of the Managing Committee are: W. J. Dick, consulting mining engineer to the Commission of Conservation; E. B. Jost, hydraulic engineer of the Department of Railways and Canals. The other members of the committee consist of S. J. Fortin, structural engineer, Department of Public Works; J. H. McLaren, hydraulic engineer; and W. F. McK. Bryce, city engineer's staff. The affairs of the Ottawa branch are in a flourishing condition, it being reported that there is a surplus of about $1,200. The past year was one of the most successful and prosperous in the history of the branch.

Officers of Saskatchewan Branch C.S.C.E.

The election of officers at the annual meeting of the Saskatchewan branch of the Canadian Society of Civil Engineers, held on January 10, 1918, resulted in the following appointments: Chairman, G. D. Mackie, Moose Jaw; vice-chairman, H. S. Carpenter, Regina; secretary-treasurer, J. H. deStein, Regina; executive committee: H. R. Mackenzie, Regina; E. G. W. Montgomery, Regina; W. H. Greene, Moose Jaw; C. J. Yorath, Saskatoon; J. E. Underwood, Saskatoon.

At the last council meeting of the Canadian Society of Civil Engineers a vote of sympathy to the family of the late Professor C. H. McLeod was passed.

Mainly Constructional

East and West—From Coast to Coast

A proposal to take over the port of St. John and make it a Dominion property, under a commission similar to the harbor commission at Montreal, is being taken up by the Dominion Government.

About February 1 the Toronto Builders' Exchange will remove from their present quarters in the Goodyear Building to the O'Neil Building, on the southwest corner of Adelaide and Victoria Streets.

Work on the Dufferin Street section of the relief trunk sewer, in St. Catharines, Ont., is progressing rapidly, being about half completed. The contractors finish about 50 or 60 feet each day, using a day shift for the excavation work only and the night shift for the construction of the sewer. The work will probably reach completion early in March.

The total value of the building permits issued in Stratford, Ont., for the year 1917 was $216,338, an increase over last year of $25,719. Of this total $125,550 went towards the erection of dwellings, the number of permits for this class of work being 86. The total number issued was 270. The largest piece of work was the Shakespeare School addition, costing $26,000.

Undermined by the flooding Capilano River, the east abutment of the reinforced concrete bridge on Marine Drive, connecting North and West Vancouver, sank about fourteen feet on New Year's Day and twisted the structure out of shape. This bridge was build in 1915, at a cost of $40,000. It is expected that the necessary repairs will cost in the neighborhood of $10,000.

The Executive Committee of the Ontario Good Roads Association has decided to hold the annual convention in Toronto, February 27 to March 1, inclusive, in the York County Buildings, Adelaide Street East. This will be the sixteenth annual convention, and the attendance is expected to be about 300. During the same week the annual conference of county road superintendents will be held at the Parliament Buildings.

Toronto harbor work during 1918 will be confined to the sea wall on Ashbridge's Bay, and operations on the breakwater will be suspended indefinitely, according to a recent government announcement. This does not mean, however, that there will be any great reduction in the work this year, as it is expected the Harbor Commission will proceed on the Ashbridge's Bay section on almost as large a scale as last year.

The R. H. Howes Construction Company, of Boston and New York, are commencing shipbuilding operations in Nova Scotia, having leased the late James Cosman shipyards, at the mouth of the Meteghan River. Mills and pattern shops have also been erected, and are now in operation. The company recently closed a deal for a tract of 500 acres of valuable timberland on the Meteghan River, and a large gang of men is now engaged on the property getting out ship framing and timber.

On the evening of Saturday, January 12, Mr. G. H. Duggan, chief engineer of the St. Lawrence Bridge Company, gave an address on the Quebec Bridge before before the Royal Canadian Institute in Toronto. Lantern slides were shown, and Mr. Duggan took up the history of the bridge, from its early stages as far back as 1899. In the latter part of his address he dwelt on the technical side of the work, telling something about the construction and strength of the bridge. He also showed photographs of every stage of the work.

Additional contracts have just been awarded by the Ontario Power Company in connection with extensions to the Niagara plant, the Canadian General Electric Company being the successful tenderer for the installation of two generators, and the turbines to be bought from the Tallahassee Power Company. The placing of these contracts is the sequel to the recent meeting of the Hydro-Electric heads with the Ontario Government, the endorsement of the provincial authorities having enabled the Ontario Power Company to negotiate a loan of $1,250,000 for power plant extensions with the Bank of Montreal. The government does not anticipate difficulty in securing moneys necessary for the carrying forward of the Chippewa scheme.

Personals

Mr. H. R. Safford, M.C.S.C.E., chief engineer of the Grand Trunk Railway, has been nominated for the vice-presidency of the American Railway Engineering Association.

Mr. David J. Davidge has been appointed secretary of the Toronto Builders' Exchange, to succeed Mr. George McSweeny. Mr. Davidge is well qualified to fill the position, having been associated with the well-known firm of Davidge & Lunn, general contractors, for the past three years.

Mr. George B. McSweeny, who has been associated with the Toronto Builders' Exchange for the past four years as assistant secretary and latterly as secretary, has received a commission in the Royal Naval Flying Corps and has gone to England to take his training. Mr. Frank Saunders, on behalf of Mr. McSweeny's many friends in the exchange, presented him with a steamer trunk, a traveling bag, and purse of gold.

Obituary

Flight-Lieutenant George Allan Cockburn, of Toronto, reported missing last November, is now reported killed in action. Flight-Lieutenant Cockburn was a graduate of St. Andrew's College and a third-year science student at Toronto University. He went to France with the Third Howitzer Battery, but after being wounded in October, 1916, he was transferred to the Royal Flying Corps.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Guelph, Ont.
The Wellington and Guelph Suburban Road Commission has been organized, and will carry out a plan for improvement of 31 miles of suburban roads. Secretary, George Penfold.

London, Ont.
Plans are being prepared and tenders will be called shortly for 8-in. sanitary sewer costing $3,500 for Cheapside Street for the City Council. Engineer, H. A. Brazier.

Marysville, N.B.
Town Council contemplate the construction of sewers costing $5,000. Clerk, A. D. MacPherson.

Picton, Ont.
Town Council contemplate the installation of a 1,000 gallon per minute capacity waterworks pump. Clerk, P. C. Macnee.

St. John, N.B.
The City Council contemplate the construction of permanent pavement on Main Street. Engineer, Wm. Murdock.

Toronto, Ont.
The York County Highways Board will ask the County Council for $150,000 for road work for 1918. Engineer, E. A. James, 57 Adelaide Street East.

Wallace, Man.
By-law has been passed and tenders will likely be called in February for the construction of highways and roads costing $48,000. Secretary-treasurer, Wm. Whiteford, Virden.

CONTRACTS AWARDED

York Township, Ont.
Mitchell & Mohan, London, have the general contract for watermain on Buttonwood Avenue for the Township Council.

Railroads, Bridges and Wharves

Anderdon Township, Ont.
By-law has been passed and tenders will likely be called for the erection of bridges costing $13,000 over the Canard River. Engineer, J. J. Newman, Fleming Block, Windsor.

Cap de la Madeleine, Que.
Plans are being prepared for three stations costing $6,000 for the Three Rivers Traction Co., St. Maurice St., Three Rivers. Manager, W. Baptist.

Sangudo, Alta.
The Canadian Northern Railway, head office, Toronto, contemplate the erection of a station. Engineer, A. T. Fraser, C. N. R. Station, Edmonton.

Public Buildings, Churches and Schools

Calgary, Alta.
The Military Hospitals Commission, 22 Vittoria St., Ottawa, and the Provincial Government, contemplate the erection of a convalescent home. General superintendent, J. H. W. Bower.

East Point, P.E.I.
C. B. Chappell & Hunter, Des Brisay Bldg., Charlottetown, are preparing plans for $25,000 brick church for the Roman Catholic Congregation.

Edmonton, Alta.
The Young Women's Christian Association, 103rd Street, contemplate the erection of a Y. W. C. A. building. Address, General Secretary.

Georgetown, P.E.I.
The Roman Catholic Congregation are having plans prepared for a $20,000 stone church. Architects, C. B. Chappell & Hunter, Des Brisay Bldg., Charlottetown.

Golden Spike, Alta.
The Govenor School District No. 3464 will call tenders shortly for the erection of a public school. Secretary, J. F. Phelan.

Joliette, Que.
Soeurs des Saints Coeurs Jesus-Marie, 28 St. Louis St., contemplate the erection of a stone and cement addition.

Ottawa, Ont.
Separate tenders received by the architects, J. A. Pearson and J. A. Marchand, Centre Block, until noon, February 5 for (a) rolled steel casements, (b) bronze covered frames and sash for the Parliament Buildings.

Parkland, Alta.
Tenders will be called shortly for the erection of a public school for Litchfield School District No. 3496. Address, Secretary, R. Melbourne.

St. Jean de Dieu, Que.
Plans and specifications with the pastor, Rev. J. A. Ouellet, who is receiving tenders for furnaces, hot water and steam heating system for church and sacristy for the Church Congregation.

Toronto, Ont.
The Health Department has included $56,000 in estimates for a new central heating plant at the Isolation Hospital.

Trail, B.C.
City Council contemplate the erection of fire hall, etc. Clerk, Wm. Monypenny.

Trenton, Ont.
The First Presbyterian Church will call tenders shortly for the erection of a church hall and also contemplate the erection of a church. F. R. Clayden, D. McK. Reed and Robt. Logan are members of the building committee.

CONTRACTS AWARDED

Glace Bay, N.S.
D. J. McIsaac has the general contract for $4,000 frame temporary church for the Roman Catholic Episcopal Corporation of Antigonish.

Montreal, Que.
J. B. Gratton, 600 Labrecque St., has the general contract for alterations costing $4,000 to offices for the Department of Public Works & Labor, Provincial Government.

South Osgoode, Ont.
Murphy & Morrow, Billings Bridge, Ottawa, have the plastering, and Jos. Meagher, Hinton St., Ottawa, the carpentry contract for $15,000 church for St. Johns Congregation.

Business Buildings and Industrial Plants

Cap de la Madeleine, Que.
Isaie de Grand' Mont contemplate the erection of a $12,000 brick store.

Dartmouth, N.S.
The Consumers Cordage Company will make repairs to their cordage plant. Superintendent, R. L. Graham.

Griffin Creek, Alta.
The Social Society and United Farmers' Association have secured a site on which they plan to erect a hall. Secretary, Cecil McKenzie.

Halifax, N.S.
Hillis & Sons Ltd., Hollis St., plan to rebuild their foundry. Secretary-treasurer, L. J. Kaye, Hollis St.

Hamilton, Ont.
The Canada Steel Goods Co., Ltd., Arthur St., contemplate the erection of a $150,000 four-storey reinforced concrete factory. Manager, A. F. Hatch.

The Canada Steel Goods Co., Ltd., Arthur St., will erect a $3,000 one-storey frame storage warehouse and will carry out the carpentry.

Lake Isle, Alta.
The United Farmers of Alberta contemplate the erection of a large hall. Address, local secretary.

Listowel, Ont.
J. W. Schinbein will rebuild business block on Main St. which was recently destroyed by fire at a loss of $25,000.

London, Ont.
The McClary Mfg. Co., 333 Wellington St., will remodel building into offices at a cost of $3,500. Superintendent, Col. W. M. Gartshore.

Tenders will be called about February 15 for the erection of a $50,000 office building for the Huron and Erie Company, Richmond St. Architects, Watt & Blackwell, Bank of Toronto Building.

Montreal, Que.
The Royal Bank of Canada, 147 St. James St., Montreal, have secured a site

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A Timely and Country-Wide Adoption of Daylight Saving is Wanted

DAYLIGHT saving, which during last summer received more favorable consideration than ever before, is again coming into prominence with arguments in its favor made more forceful by reason of the present endeavors to conserve fuel and artificial light. The movement for the consummation of a universal daylight-saving bill should now receive the attention it deserves in order that the benefits of the scheme may be derived early enough to make them worth while. Daylight saving is backed by the electric railways in the United States at least, the sentiment of which is expressed in a recent editorial in the Electric Railway Journal: "In all the zeal of carrying on campaigns for higher fares and co-operating with the government in the various suggested ways for the conserving of fuel, it should not be forgotten that one desired innovation has not yet been effected—daylight saving. A bill to move forward the clock one hour during the warm months should now be enacted into law. Daylight saving would be a boon to the nation's workers and the inertia of conservatism, the only opponent, should be overcome."

The trouble with the application of a daylight saving scheme in the past has been that it was not demanded or vigorously urged as a national necessity. The acceptance of a saving plan was dependent on the whims and desires of individual municipalities; it was not the subject of national legislation. The fallacy of such lack of concentrated effort is obvious, for no widespread benefits are to be derived and only endless confusion caused by an arrangement that sets the clock ahead in one community and leaves it unchanged in an adjoining municipality. If the supreme advantages inherent in a properly formulated daylight saving plan are to be realized, the principles must be universally applicable and uniformly adopted. Daylight saving should be the subject of national—and even international—legislation; its adoption in every community of Canada and the United States will secure for the people a boon which will prove extremely profitable at the present time when conservation is the order of the day.

To further derive the maximum benefit from the inauguration of a daylight saving plan, its adoption must not, as last year, be delayed until so late in the season as to offset the advantages that otherwise may have accrued. Sentiment this year is sufficiently in favor of the idea to warrant early legislation without the procrastination that characterized last year's endeavors. Let our legislators, therefore, keep daylight saving in mind, that, as soon as opportunity permits, its merits may be appreciated by a country-wide and timely adoption.

Amendments to Ontario Lien Law Under Discussion

A MEETING of the Toronto Builders' Exchange was held on Thursday afternoon, January 24, in their office in the Goodyear Building, to discuss changes and improvements in the Ontario Lien Law. Representatives of the builders, supply men, architects and the building trades' council, were present. Mr. W. E. Dillon, the president of the Exchange, was in the chair.

The clause around which the discussion centred was that which provided that the sub-contractors or supply men can place, any time within thirty days after the completion or abandonment of the work, a lien for the amount due them for work or materials. The weakness appears to be that while the proprietor is entitled to retain 20 per cent. of the contract price to meet these liens and those of the workmen, this sum is frequently altogether inadequate to cover the unpaid debts. Thus, in a case of this kind, the only person who benefits by the working of the Act, is the fly-by-night contractor who undertakes a job he cannot finance and leaves his creditors to depend on their liens for payment.

Mr. Hynes, of Hynes, Feldman & Watson, suggested as an amendment that, in order to establish his right of lien, the dealer or sub-contractor should notify the proprietor that he is about to deliver material or do work on any job and that he claims the right to lien for this amount in default of payment. In this case the proprietor would be liable for the full amount of the debts incurred, and ought to be able to withhold from the contract price any amount necessary to cover them—not a limit of 20 per cent. The supply men raised objections to the suggestion on account of existing methods of ordering and delivery. Also the placing of a lien before shipment was liable to show the contractor in an unfavorable light. Mr. W. E. Dillon, the president, however, seemed quite favorable to the suggestion, though no decision was reached. It was decided to obtain a copy of the Michigan and other state building laws and discuss the question at a later meeting.

Another point noted was that the clause referring to the workmen's right to lien stated that no officer, architect or foreman nor any person receiving more than $5.00 per day should come under the ruling of the Act. As many workmen are now receiving a larger wage than this, they would thus be without the right of lien.

The question which has been raised by the Toronto Builders' Exchange in regard to the working of the lien law is of interest to the building trade throughout the province and no doubt suggestions or criticisms from members of the trade would be welcomed.

Guelph City Engineer Urges Street Maintenance

CITY ENGINEER McARTHUR, of Guelph, Ont., has submitted to the Sewerage and Public Works Commission of the city his report, covering the work carried out in 1917 and embodying recommendations for the present year. He made particular reference to the condition of the city's streets and the necessity for repair and maintenance work, pointing out that, if works for which large sums have been expended are allowed to go beyond repair, the result is gross extravagance rather than economy. Guelph has about 132,000 square yards, or practically 5.3 miles, of paved streets, and of this amount, the report stated, there was only one block — Liverpool Street—not in need of repairs. For the year 1917 the sum of $14,500 was appropriated by the City Council for the current expenditure, under the direction of the Sewerage and Public Works Commission, and this sum was later increased by $2,500, making a total of $17,000. The total amount expended was $16,990.78. Of this, $483.63 was required for cleaning, flushing, and repairing sewers; $3,520.37 for the sewage disposal plant; $8,988.68 was spent under the Board of Works account, exclusive of that laid out in actual street repairs. Thus the sum left for repairs and maintenance of highways was only $3,994.90. Guelph has a total of 55 miles of streets, so that the expenditure per mile was less than $80. The original construction cost of the paved section alone was $313,026.49.

As regards new paving, the report stated that plans had been prepared and the storm drainage system was almost completed, ready for the paving of Gordon Street, from Waterloo Avenue to Dundas bridge. The question of paving Ontario Street and York Road had also been taken up, but while this work would doubtless be of great benefit if finances permitted it, the greater importance of saving pavements already laid than of entering upon new work was pointed out.

The report stated that the amount of work done in the construction of new domestic sewers was probably the smallest for any one year since the first installation of the sewerage system, only a few short pieces being laid. Reference was made to complaints being made regarding the pollution of the river below the sewage outlet, and, in view of the fact that legal action was threatened, new plans were being prepared for a more effective system of disposal.

In concluding his report, the city engineer stated that his recommendations regarding necessary street maintenance work were made after giving all due consideration to the extreme conditions occasioned by the war, and he felt that the carrying out of such work would be a real economy. He said, however, that there were certain works, particularly sidewalks and sewers, for which petitions were continually being presented, but which he thought, in view of the present financial stress, might be postponed, though some inconvenience might be caused thereby.

The Fatal Handicap of a College Education?

Two advertisements that recently appeared in the same issue of a technical magazine.

A college graduate in electrical engineering wanted, with one or two years' experience, for work along technical lines, in a permanent position on telephone office equipment in Buffalo, N. Y. Will pay $16.00 per week for man with one year's experience and $18.00 per week for man with two years' experience.

At once, experienced pile driver wanted, and dock-builder foreman for government job, Philadelphia; average wages $60.00 per week. Write giving experience in detail and earliest date of starting.

Steel Output to Be Increased 20 Per Cent.

As a result of a conference between the War Committee of the Dominion Cabinet and the Canadian steel manufacturers, it is announced that the latter have undertaken to increase their steel output by 20 per cent. over that of last year. This should be of benefit not only so far as the manufacture of munitions is concerned, but also to the railways. Owing to the immense amount of steel being put into munitions there has been a shortage of material for the production of rails, and the requirements of the railroad companies have had to stand aside. The maintenance of the roads, however, demands an adequate supply of rails, and the increased output of steel during this year will probably be sufficient to relieve the situation.

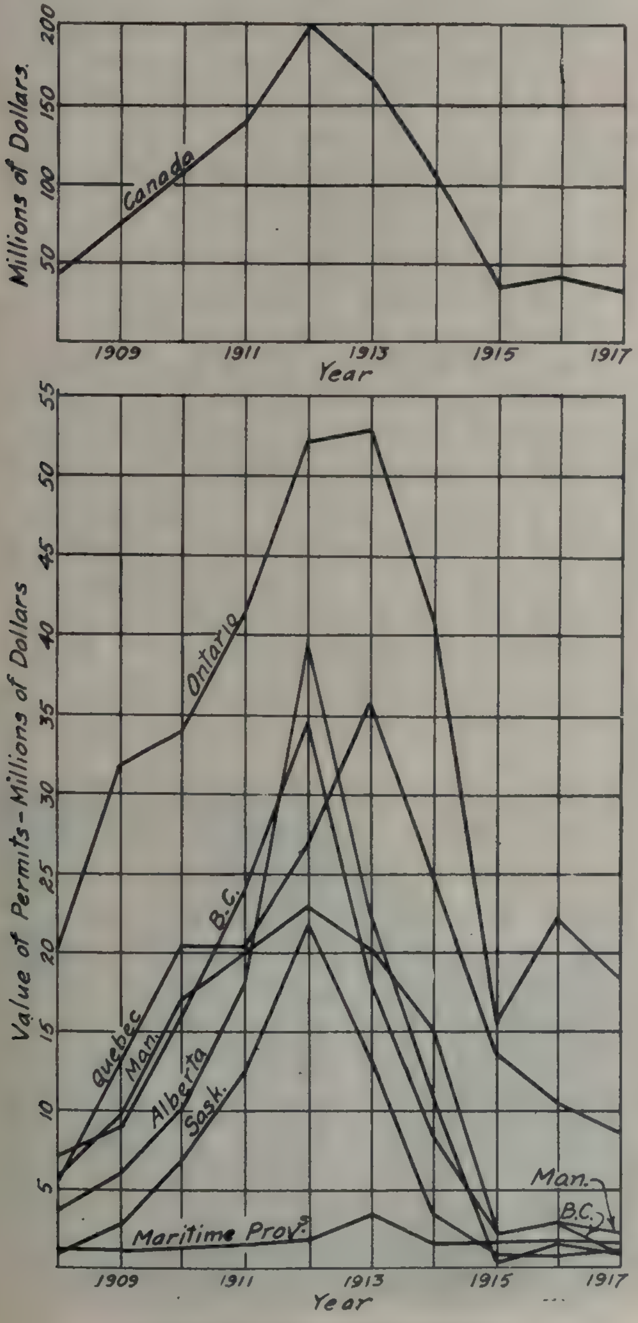
Doctors Are Really Engineers

Col. W. O. Owens, in charge of the Motion Picture Department of the American Medical Museum in Washington, declared recently at the convention of the American Society of Mechanical Engineers that he had come to look upon doctors and medical men as biological engineers, inasmuch as their chief business was to keep the human engine in perfect working order. His statement was emphasized by Major Frank B. Gilbreth, of the Engineer Officers' Reserve Corps, who described how the soldiers crippled in the war are provided with means for performing useful industrial work and making themselves self-supporting.

Building Permits for 1917

Seventeen Per Cent. Drop Accounted for by Lack of Munition Factory Construction, Prolongation of War and Excluded Government Contracts

FOR the year just closed, the value of building permits issued in the chief cities of Canada shows a decline from the value of those taken out in 1916. From the information collected in 53 towns and cities, a total of $35,019,318 was reached in 1917, as compared to $42,642,324 in the previous year. This represents a decrease of 17 per cent. To illustrate how the value of building permits has fluctuated during the past few years, the accompanying curves have been prepared, indicating the variations from 1908 to 1917 for each province and for the country as a whole. It will be observed that the total of the permits issued last year was the lowest of any year recorded in the chart, even below the record of 1915, which showed a very marked decline owing to the war. When 1916's permits reached a value 18 per cent. in excess of 1915's, it was felt that the backbone of the slump had been broken and that perhaps succeeding years would witness continued improvement. The decline registered during 1917, however, does not entirely support this hope. However, it must be remembered that a large portion of war building, by which is meant the construction of munition and kindred shops, has now ceased. During 1916 there was a vast development in this regard, but the needs of the situation are at present pretty well accommodated, so that munition factory erection has not been as vigorously continued, though during the past year there has been considerable military hospital work; this, however, being a government development, is not shown for the most part in the permits list. Many other large government public works, involving millions of dollars, are also not taken into consideration.



Variation in value of building permits.

Rural Building Not Included

The permit values as shown in the table and curves are not entirely satisfactory guides, either, in regard to building developments that have taken place in the rural and suburban districts outside the limits of the cities listed. Such projects as the flying corps camps, for instance, are not taken into consideration. The comparatively poor showing in 1917 can be further accounted for, perhaps, by the elimination of all unnecessary building as the war continues. The prolongation of the struggle has meant that people will hold over as much construction work as possible unless it is urgently required by the demands of war.

Taking the permits by provinces, all the provinces except Saskatchewan show a decrease. The latter, on the other hand, exhibits an increase of nearly 73 per cent. The percentage drops in the other provinces vary from 60 per cent. in British Columbia to only 3.6 per cent. in the Maritime Provinces. As observed in the curves, the Maritime Provinces are consistently steady in building activities without extremely pronounced peaks or valleys. Ontario still maintains its usual lead, the value of permits in the province for 1917 being 53 per cent. of the total for the Dominion; in other words, the value of permits in Ontario exceeds that of all the other provinces combined.

The following table gives details of the permits in the 53 cities and towns of Canada during 1916 and 1917.

Comparative Building Permits for 1917 and 1916

Maritime Provinces	1916	1917		Change
Halifax	$1,226,329	$804,549	†	$421,780
St. John	464,350	531,250	*	66,900
Sydney	128,105	416,900	*	288,795
Quebec				
Maisonneuve	180,345	993,780	*	813,435
Montreal	5,334,184	4,387,638	†	946,546
Outremont	453,038	173,385	†	279,653
Quebec	2,913,157	2,459,386	†	453,771
Three Rivers	537,345	422,950	†	114,395
Westmount	545,754	155,890	†	389,864
Sherbrooke	425,000	166,000	†	259,000
Ontario				
Brantford	282,677	287,195	*	4,518
Brockville	170,420	67,282	†	103,138
Chatham	1,338,924	390,997	†	947,927
Fort William	414,025	658,265	*	244,240
Galt	253,795	186,430	†	67,365

Guelph	155,222	111,435	†	43,787
Hamilton	2,405,781	2,733,865	*	328,084
Kingston	184,321	150,705	†	33,616
Kitchener	324,838	205,352	†	119,486
London	926,125	837,890	†	88,235
North Bay	15,870	22,000	*	6,130
Ottawa	1,530,400	1,041,017	†	489,383
Peterboro	127,975	953,383	*	825,408
Port Arthur	1,565,095	1,345,174	†	219,921
Preston	36,850	25,000	†	11,850
St. Catharines	616,515	448,003	†	168,512
St. Thomas	141,165	75,925	†	65,240
Stratford	190,619	216,278	*	25,659
Sudbury	165,500	140,565	†	24,935
Toronto	9,881,671	7,163,556	†	2,718,115
Welland	202,587	241,334	*	38,747
Windsor	1,508,330	1,163,375	†	344,955
Woodstock	88,806	91,730	*	2,924
Manitoba				
Brandon	246,748	180,338	†	66,410
St. Boniface	135,392	....		....
Winnipeg	2,507,300	2,212,450	†	294,850
Saskatchewan				
Moose Jaw	318,945	295,460	†	23,485
Prince Albert	66,330	4,000	†	62,330
Regina	222,075	416.460	*	194,385
Saskatoon	146,150	582,739	*	436,589
Yorkton	35,675	63,445	*	27,770
Alberta				
Calgary	663,500	549,500	†	114,000
Edmonton	213,940	359,800	*	145,860
Lethbridge	84,122	53,498	†	30,624
Medicine Hat	410,000	102,455	†	307,545
Red Deer	29,180	....		......
British Columbia				
Nanaimo	14,606	24,674	*	10,068
New Westminster	85,307	81,515	†	3,792
Prince Rupert	28,300	99,000	*	70,700
South Vancouver	98,602	....		......
Vancouver	2,412,889	768,255	†	1,644,634
Vernon	17,880	9,370	†	8,510
Victoria	170,265	147,875	†	22,390

* Increase. † Decrease.

Large School in St. John, N.B.

St. Vincent's High School, One of the City's Finest Institutions—Details of Plan and Construction

THE St. Vincent's Girls' High School is the latest addition to the group of church buildings of the cathedral parish in the city of St. John, N.B. Other buildings in this group are the Cathedral of the Immaculate Conception, Bishop's Palace, Home of the Good Shepherd, St. Vincent's Convent and School, infirmary, St. Vincent's Chapel, maternity hospital, infants' home, Catholic Girls' Guild, and the Young Men's Catholic Institute.

From the standpoint of design and accommodation the St. Vincent's High School is worthy of note, being unsurpassed in this respect by any other school building in the city. In addition to the regular school equipment, an auditorium, with a seating capacity of over 800, has been provided; also a well-equipped gymnasium and a swimming pool, 25 x 50 ft. The tank is of white hexagonal tile, and the floors of the tank-room are of similar material, while the wall panels and showers are of Tenessee marble. Dressing, dry, and locker rooms, with individual steel lockers, are also provided. A special heating plant is used for heating the water in the tank.

The high school building is 125 x 140 ft. over all, and faces south on Cliff Street. The original design called for fireproof construction, with steel frame and concrete floors throughout, but the enormous increase in the cost of labor and materials made it advisable to abandon this, and the steel frame was redesigned and much of the concrete floor replaced with wood construction, thus rendering the structure only semi-fireproof. No special methods were employed in the construction. Most of the material for the masonry work was hoisted in barrows on a platform elevator of standard design, while the steel was set with a pole derrick and the stone with two stiff-leg derricks.

Second floor view.

The gymnasium floor over the auditorium is carried on heavy steel plate girders, and the roof over the gymnasium is supported by steel trusses, leaving all floors clear of posts.

The building consists of a basement and three storeys, the general layout being as follows: Basement—Swimming pool. dressing, locker, shower, and dry-rooms, apparatus room, chemical laboratory, furnace room, and fuel storage. Ground floor—Auditorium, four class rooms, teachers' room, office. First floor—Gymnasium, four class rooms, teachers' room, sewing room, library. Second floor—Four class rooms, domestic science laboratory. Lavatory and toilet accommodation is provided on every floor.

The walls of the building are of cream tapestry brick, laid in black mortar, with raked joints, and the basement exterior is of rock faced grey granite, with tooled base course and trim. The front entrance and

Construction proceeding on Cliff Street front.

steps are also of tooled grey granite and are of very massive and pleasing design.

All interior partitions are of brick to afford protection against rapid spread of fire, and tower fire escapes of special design are provided on the exterior.

The windows are large, to give a maximum of light and ventilation, and, in addition, there is an elaborate system of ventilating flues serving every room. A permanent vacuum cleaning plant is one of the features of the equipment.

Y. M. C. I. Building

Another recent addition to the same group of buildings is the Young Men's Catholic Institute. This building is faced with cream tapestry brick, laid up with black mortar and raked joints, the same as the high school building. Features worthy of note in the equipment are a 30 x 40 ft. tile swimming pool, showers, a large gymnasium, four bowling alleys, billiard, reading and recreation rooms, library, and a large auditorium.

The St. Vincent's High School was designed by C. W. West, architect and engineer, of St. John, N.B. The contractors for this building and also the Y.M.C.I. were John Flood & Son, of St. John.

Toronto Builders' Exchange Annual Meeting

THE annual meeting of the Toronto Builders' Exchange was held on Monday, the 21st inst., when the following were elected directors for 1918: W. E. Dillon, president; S. R. Hughes, past-president; Walter Davidson, vice-president; A. D. Grant, first vice-president; John Aldridge, treasurer; Geo. Oakley, Chas. Bulley, Wm. Clark, Jr., E. Gearing, James Munro, Geo. Gander. Messrs. Arthur N. Dancy and John Barnes were appointed auditors. The secretary is Mr. D. J. Davidge.

The general business of the exchange was transacted afterwards. One point of importance taken up was the selecting of new quarters, the Goodyear Company, owing to the growth of their business, having requested a large portion of the flat held by the Exchange. A committee was appointed to procure new premises, and the choice was for a portion of the third storey of the building on the southwest corner of Adelaide and Victoria streets. This being a central location, it was felt that it would be more convenient for the members. Although business was rather quiet, the members were optimistic in their views of the future. Different unions having made demands for higher wages, committees of both parties were working to settle these questions. The Compensation Act and Lien Law were criticized and the members felt that both had room for improvement.

Mr. Geo. McSweeney, the late secretary, has joined the R. N. F. Corps, and was presented with a steamer trunk, club bag and purse of money, the members wishing him the best of luck and safe return.

The membership committee, comprising Messrs. James Munro, C. T. Penn, W. J. Nicholson, R. Falkiner, A. D. Grant, H. Feather, J. Scott, and H. Jennings, are making plans to start a membership campaign.

A Toronto committee is taking steps to organize a Canadian housing conference in Toronto in the spring of 1918.

Letters to the Editor

Use of Wire Mesh in Hollow Tile Construction

Editor Contract Record:

Referring to an article appearing in your issue of November 28, 1917, page 983, we desire to advise you that your source of information is in error regarding the use of wire mesh in conjunction with end or vertical construction hollow building tile.

To the best of our knowledge, no hollow tile manufacturers are in any way in sympathy with the use of wire mesh, as it offers no structural advantages, and is distinctly a means of increasing the cost of erection.

Hollow tile of the vertical cell type, when correctly designed and manufactured, is possessed of sturdy shells that permit of easy "buttering." Skilled bricklayers experience no difficulty in applying the mortar. The amount of mortar that falls in the cells is distinctly negligible, and in any other masonry construction falls on the ground. In the former instance the insulating value of the air cells is not injured.

It is our opinion that wire mesh used in the mortar joints, as the article suggests, would soon rust out, thereby losing any theoretical value it is supposed to possess, and this rusting process would very likely stain the interior plaster which is applied directly to the tile.

Yours very truly,
National Fire Proofing Company of Canada, Ltd.,
M. F. Gibson, General Manager.

Credit for Design of Quebec Bridge Erection Equipment

Editor, Contract Record:

In your issue of January 9 I notice an article written by Mr. A. J. Meyers, a member of the staff of the board of engineers, describing the erection traveller used in connection with the erection of the Quebec Bridge, but note with regret that credit was not given to the St. Lawrence Bridge Company, who originated and developed the design for this very important piece of erection equipment.

I would like to take this opportunity of stating that the plans for the superstructure and the entire plant and equipment used in connection with the erection of the bridge were worked out in the offices of the St. Lawrence Bridge Company, who, according to the terms of the contract, were entirely responsible for its successful completion, and great credit is due their engineers for the work they have done in this respect, since they had little or no precedent to guide them.

Yours very truly,
C. N. Monsarrat,
Chairman and Chief Engineer,
Board of Engineers, Quebec Bridge.

Mr. Wm. D. Uhler, President of the American Association of State Highway Officials, one of the best known roadway engineers in the United States, has been commissioned as a major in the Ordnance Reserve of the United States army.

Canadian Society of Civil Engineers Holds Momentous Annual Meeting

Broadened Scope Under Change of Name, Recognition of Valor of Members in the War, and Discussion of Fuel Situation are Features

TWO features stood out in the proceedings of the annual meeting of the Canadian Society of Civil Engineers (or, to give it the new name, The Engineering Institute of Canada), held on January 21-23, at the society's rooms, Montreal—the unveiling of the honor roll of the members who have joined overseas forces and the paper on "The Fuels of Canada," by Mr. B. F. Haanel.

The unveiling of the roll, placed in the lobby of the building, was a very impressive ceremony, performed in the presence of a large number of members, many of whom have relations at the front and some of whom have lost their sons. It was, appropriately, a very quiet function, the speeches being in a key befitting the occasion.

The paper on fuel, full of interesting data, was followed by a discussion emphasizing the serious situation and the need of engineers taking a strong stand in getting action with a view to the development of our natural resources, now to a certain extent dormant.

It was apparent from the general proceedings that the society intends to take more energetic action to increase its scope. The report on society affairs and the revised by-laws are steps in this direction. The council have set themselves to rectify certain matters which admittedly retarded progress and caused dissatisfaction and to obtain closer co-operation between the members.

The speech of Mr. H. H. Vaughan, the new president, was an emphatic endorsement of the new order of things, designed to embrace all branches of the engineering profession, not recognizing sectional qualifications and placing all engineers on an equality. Mr. Vaughan, however, makes an appeal to the members to do their part in this work; the revised by-laws are but a means to an end, and the president asks for assistance in backing up the efforts of the council. The annual meeting passed off very smoothly, and was notable for an absence of that criticism which characterized some previous gatherings.

President Devoting Energies to Recruiting

The first day's sessions were, as usual, confined to purely business matters, reports of committees and of the branches, with discussions. Col. C. N. Monsarrat presided, in the absence of Col. J. S. Dennis, the president, who wrote from Chicago explaining why he could not be present. The letter, in part, was as follows:

"For something over six months, at the request of the Canadian Government, and as second in command of the British-Canadian Recruiting Mission in the United States, I have been devoting all my energies to the matter of endeavoring to secure recruits in the United States for our army. Our efforts have met with a fair measure of success, as will be indicated by the fact that up to date we have sent to Canada something over 16,000 men.

"These duties have been such that it has been impossible for me during that period, as your president, to fulfil any part of my duties in connection with the society's affairs. In the early part of the year I tried to do what I could to assist in the reorganization of the society so that its affairs might be put into a good condition, and I hope that you will be satisfied with the work then initiated, and which during the latter half of the year has been carried out so loyally by the members of the council, with the assistance of our able secretary, with the desired effect of rehabilitating the affairs of our society and putting them in good standing.

"My personal thanks are due to the vice-presidents, secretary, and the members of the council for the loyal way in which they have carried on the work without any assistance from me; and, while it was hoped during the year that when the annual meeting was held I would have been able to preside, and feel that you appreciated the efforts made during the year, I hope that those in attendance will realize that only the importance of the duties that I am performing here has deprived me of that pleasure, and will feel that as your president the work that I have been able to accomplish in the United States has added one more evidence, if any were needed, that the members of the engineering profession attached to our society have been doing their bit to help Canada in our great struggle.

"I especially regret that I will not be present at the unveiling of our roll of honor of our members who are serving at the front. I feel that that roll can, for all time, be pointed to as an evidence of the fact that the C.S.C.E. has responded nobly to the great cause, and has proved, if any proof were needed, that the members of the engineering profession are always found in the front rank when duty calls."

After the appointment of the scrutineers the meeting proceeded with the reports. The first was that of the council. This was reproduced practically in full in our last issue, January 23. On the motion of Mr. W. J. Francis, seconded by Mr. H. R. Safford, the report of council was received.

The council reported passing a resolution recording its sense of great loss by the death of Professor C. H. McLeod (for 25 years secretary of the society), who for over 40 years was personally interested in the engineering education of a great number of young Canadians, and who had ever before him the best interests of the engineering profession in Canada. A suitable brass tablet to the memory of Professor McLeod is to be prepared.

The Finance Report

Mr. R. A. Ross, in moving the adoption of the finance report, pointed out that, in spite of the difficult times, they had a surplus. He also referred to the fact that although the committee had been active in collecting arrears of over $6,000, there were still $20,000 outstanding. The greater part of this amount would probably have to be wiped off the books, as they would do well if they collected $5,000 or $6,000 of this amount. The arrears were not caused by the absence of members at the front, but was money that it was almost impossible to collect. If the society had received the contributions of men at the front there would probably be an additional $10,000 on the right side.

The Library Committee's Report

The Library Committee, in its report, made several recommendations, including "that an effort should be made in case the society decides to publish a monthly magazine to obtain, either by ourselves or through an arrangement with some of the American societies, a monthly review of the articles published in the different technical periodicals."

Mr. M. J. Butler, referring to this recommendation, doubted the wisdom of the society running the risk of publishing a technical magazine.

Mr. H. H. Vaughan stated that the Committee on Society Affairs had gone into this matter very thoroughly. The most feasible plan appeared to be one by which the society could make arrangements with one of the existing papers to publish a society bulletin. Nothing had been definitely decided, but he was of opinion that an arrangement of the kind referred to would give what was required. The matter would have to be left to the council, who would not incur any great expense. He believed that an arrangement of the kind he spoke of would be of financial benefit to the society, as well as a desirable thing.

Mr. Butler was against establishing a paper in competition with existing engineering papers which might hurt them.

Mr. J. White agreed with Mr. Butler, and was absolutely opposed to any action likely to be detrimental to existing journals. They must be careful not to antagonize any engineering or quasi-engineering papers.

Mr. R. A. Ross pointed out there were three propositions to be considered—one to issue a bulletin; another was to control the editorial columns of an existing paper, which would bring the opposition of other papers; and, if the society could obtain money, to publish a paper of their own. It was, he admitted, a big "if." The publication of such a paper—he did not mean by this to put in the money of the society—would provide means of getting in touch with the public, a feature which was now lacking. In such a publication they could insert articles describing the really great things done in the engineering world, and, in addition, could have news of the society's doings, and thus bring the society in closer touch with their own members.

Mr. Francis was very much in agreement with Mr. Vaughan. A committee of the council was dealing with this matter, as they fully realized the need of some means of communication between the members. The committee were not going to take any action which would load up the society with expense; there was a way out of this question at a less cost than establishing a new paper, and he felt satisfied the committee would bring in a report which would be satisfactory.

The report was adopted.

Reports of Branches

This was followed by the reading of the reports of the various branches and divisions. Practically all showed considerable activity, notwithstanding the adverse war conditions. Several of them referred to the large percentage of members overseas and to the severe casualties. In the Western reports allusion was made to the visits of the president and to Mr. Fraser Keith, the secretary, it being stated that these visits proved of material assistance in arousing interest in the branches' doings and in increasing the general spirit of loyalty to the society. The following is a summary of the various reports:

Manitoba—Twelve meetings were held in addition to those of the electrical section. The branch now numbers 203 members, 59 of whom are on active service; four have been killed.

Toronto—Thirty-three and one-third per cent. of the members are overseas; 20 meetings were held, in addition to eight open meetings. Membership totals 316. The society during the past year made special reports on roads, pavements, and sewage.

Ottawa — Thirty-five per cent. of the members have joined the colors. The branch has a surplus of $1,200. The average attendance at the evening meetings was 100. The report added that the visits of the president and the secretary were very helpful, and that the branch had decided to issue as a bulletin for general distribution Mr. Keith's paper on "The Awakening Recognition of the Engineer."

Quebec—Six meetings were held, at which the predominant subject was the betterment of the engineering profession. Contributions of $200 were given to war charities. The branch has a balance of $624.

Victoria—Thirteen meetings were held. During the year the society interviewed members of the provincial government regarding the aims of the society, but, added the report, it was clear that a great deal of work had to be done to acquaint the public with the status of engineers. Thirty-three members have gone to the front, this being 40 per cent. of the membership.

Calgary—The members were very busy during the year in assisting government research work. An engineering section of the Board of Trade had been organized, consisting of the members of the branch. Questions of engineering will be referred to this section for consideration. There are 66 members.

Saskatchewan—Report showed considerable activity, nine regular meetings being held. The financial position improved and the membership also increased. Mr. Keith added that although this was the youngest branch, it had added the largest number of members during the year.

Edmonton—There are 56 members, of which 21 are on active service. The account showed a balance sheet of $69.

Alberta Division and Vancouver branch also sent reports.

It was agreed that in future the branches and divisions should submit a financial statement when forwarding the annual reports.

To What Extent Should C.S.C.E. Prepare Specifications?

Mr. M. J. Butler moved that "it is the opinion of the meeting that the subject of special committees be reconsidered by the council, and that hereafter appointments of such committees be limited to such subjects as defining the quality of material rather than the wide scope heretofore embraced in such committees."

Mr. Butler expressed the view that in drawing up special specifications the society were departing from general principles adopted by engineering societies. Specifications for the use of materials were right, but he objected to getting up standard specifications which might be used by non-technical members of town councils. Mr. Safford seconded the motion.

Mr. John Kennedy drew attention to the work of the standardization committees of the Institution of Civil Engineers and to their efforts to secure standardization practically throughout the world. The institute had placed their committee on Canada on a broader basis than, say, Australia, because Canada was a manufacturing country. The British standards were different from those of the United States, but it was expected that there would be some co-ordination of British, American, and Canadian standards. The matter had been brought before the Canadian Society of Civil Engineers, the Manufacturers' Association, and the government.

Mr. Francis thought the society was getting on dangerous ground in writing specifications which were too educative in character. The members of the society were presumed to have a certain amount of knowledge, and it was not the business of the council to issue text-books for the use of members of town councils. The society was going beyond what other professional associations were doing.

Mr. A. D. Swan supported the motion.

Mr. Vaughan enquired if this motion was aimed at the Bridge Specifications Committee. The more publicity given to specifications the better, and it was very difficult to draw the line between specifications which referred to methods of manufacture and those relating to use.

Mr. Ross urged that the council should have a free hand in this matter.

Mr. Butler recognized the paramount importance of world-wide standardization, and he supported any efforts that the society might make in the direction of co-operating with the British Institute.

Mr. Vaughan expressed himself as satisfied, as it was understood that the council would be asked to continue a bridge specifications committee.

Mr. White moved the reception of the report of the Conservation Committee, and announced that Mr. Tye had been appointed to succeed Sir Sanford Fleming as the permanent representative of the society on the Conservation Commission. The report is published on page 82.

Report of Roads and Pavements Committee

The reception of the Roads and Pavements Committee report was moved by Mr. G. Hogarth.

The report stated that, following the formation of the committee in 1915, the opinion of the members was sought, with a view to deciding on what lines information was most generally required. It appeared that a survey of the methods and costs of pavements of various types would result in the securing of valuable data, and that, in addition, there was a need for reliable specifications for the materials used in road and pavement construction.

The committee, therefore, proceeded to work on two definite lines—first, the collection of information concerning the construction of pavements, with a view to correlating it with information received at later dates indicating the success or failure of different methods of construction; and, secondly, the compilation of specifications for road-building materials.

In the report of the committee presented at the last annual meeting of the society a list of the pavements concerning which information had been received was given, specifications for crushed stone, gravel, and sand were presented for adoption by the society, and a progress report on specifications for asphaltic road oils, with tentative specifications, were included.

The specifications for crushed stone and gravel have been used by members of the committee and others, and up to the present no suggestions for improvement have been received. As there was a lack of uniformity between the specifications for concrete sand issued by the Committee on Concrete and Reinforced Concrete and those issued by this committee, it was suggested that the two committees consider the matter together, with a view to obtaining a uniform sand specification. While steps in this direction have been taken, insufficient progress has been made to enable the committee to offer a revised specification. It is anticipated that during the coming year a satisfactory specification for concrete sand will be evolved.

Progress is being made in the preparation of further specifications for materials, but they are not sufficiently advanced to submit to the society. The attention of the society should be drawn to the fact that those submitted in the last annual report of this committee were of the nature of a progress report only, and were not put forward for use by the membership, but for discussion only.

Progress has been made with regard to the collecting of information concerning the construction of pavements. During the early part of the year blank forms were sent to the engineers of 60 of the cities and large towns of the Dominion, with a request that pavements constructed under their supervision be reported on. The number of reports received, including those summarized in the last annual report of the committee, makes a total of 122 pavements, which number will be increased considerably before the end of the year. This means that the committee has under observation, through the co-operation of the municipal engineers throughout the Dominion, the aforementioned number of pavements.

Mr. Hogarth pointed out that it was desirable to continue certain investigations, and the council was therefore asked to continue a committee.

The Electro Technical Committee's Report

The report of the Electro Technical Committee was as follows:

The committee begs to report that during 1917, as in the two years previous, the committee's activities have, of course, been considerably curtailed, though the central office in London has done all that was possible under the circumstances to keep the organization together and to forward the work.

To this end, and because of the importance of the subject, a conference on the rating of electrical machinery was held in London in September, the meetings being attended by delegates from the British and United States committees, and by Mr. A. P. Trotter, consulting engineer, of London, who very kindly accepted our chairman's invitation to represent the Canadian committee. When the work of this conference is finished and all details settled, another great step will have been made towards world-wide electrical standardization, with all its attendant advantages. For instance, to mention just one: All tenders, whether from manufacturers of the same or different nationalities, will then be comparable on a uniform basis as to performance claims, guarantees, etc., a condition that has not always obtained in the past, though obviously most desirable.

The committee has to acknowledge, with thanks, the continued financial support of the Dominion Government, through the Department of Inland Revenue, whose assistance is much appreciated by both the Canadian members and the central office in London.

Finally, we have pleasure in reporting that Prof. Major L. W. Gill, of Kingston, our member overseas, continues to command his battery somewhere on the French front.

Steel Bridge Specifications

In moving the reception of the report on Steel Bridge Specifications, Mr. P. B. Motley stated that the committee had held eight meetings, in addition to several meetings of sub-committees. It might be necessary to make some additions to the specifications of fixed steel and reinforced concrete bridges so as to bring them in accordance with the specifications now submitted. These latter were recommended to the various municipalities and governments, but were not to take the place of engineers. There were, no doubt, several controversial points in the specifications, but he believed that the recommendations embodied the most recent engineering practice. The committee had been in communication with the American Railway Engineering Association, with a view to reciprocal action. Similar action might be extended to other committees say, for instance, that on cement.

Mr. R. F. Uniacke seconded the motion, which was adopted.

Publication of Suitable Papers

The report of the Education and Board of Examiners Committee was submitted by Prof. H. MacKay, who stated that the committee were endeavoring to keep up the standard of the society, and turned aside men whose qualifications did not entitle them to membership. Occasionally this had happened to men with considerable experience but whose knowledge did not stand the test.

The report of the Committee on Society Affairs (already given in the Contract Record) was received.

Mr. Safford drew attention to the fact that some of the branches were independently publishing their transactions, and suggested that, pending the determination of the society's policy regarding the bulletin, the branches should discontinue the publishing of their papers.

Mr. Ross remarked that the publication of such papers would be unnecessary under the proposed new arrangement.

The whole policy would be changed, and no action should yet be taken in regard to the branches.

Mr. Safford only desired to secure co-ordination and save funds for the general bulletin.

Mr. Francis said that the revised by-laws changed the policy of the society. Montreal would in future become a branch. Under the new arrangement, any paper, from whatever branch of the society, would be considered, on its merits, with a view to publication.

Reinforced Concrete Report

The report of the Committee on Reinforced Concrete led to some discussion. It was as follows:

When this committee was appointed by the council no instructions were given as to the line of work to be done by the committee; therefore, in the absence of anything definite along this line, they thought that a comparison of existing specifications, with report thereon, would be most beneficial to the society.

In the United States a joint committee, consisting of representatives of the American Society of Civil Engineers, the Society for Testing Materials, the American Railway Engineering Association, the United States Government, the Portland Cement Association, the Concrete Institute, the Institute of Architects, and other affiliated organizations, was formed in 1904, and have recently prepared and recommended a standard specification for cement, which has been adopted by the said societies.

These specifications, together with the British standard specifications prepared by the Engineering Standards Committee, supported by the Institute of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, and the Institution of Electrical Engineers, and other eminent engineers in Europe, were compared and analyzed.

Your committee realizing that it is desirable to have as uniform a specification as possible, compared the present Canadian specifications with the new American specification and the British specification, and decided that certain features in both specifications did not appear suitable to Canadian conditions.

Your committee recommends that the magnesia content should not exceed 4 per cent.—at least, until such time as more information may be had as to the results obtained by the use of a greater amount of magnesia.

Neat Tests Should Remain

In the American specifications the test for tensile strength with briquettes of neat cement has been omitted. Your committee feel that this test should remain, omitting the 24-hour test and reducing the 7-day and 28-day requirements to 450 pounds and 580 pounds respectively, thus reducing the tendency of manufacturers to produce cement giving a high tensile value on the shorter test, to the detriment of the longer one. The committee considers, however, that more reliance may be placed on the results obtained from the cement and sand tests.

The Canadian cement manufacturers have objected to increasing the weight of cement in each sack to 94 pounds. Your committee accordingly gave this matter mature consideration, and decided to recommend that the weight of 94 pounds per sack, as formerly recommended, should be adhered to.

Enquiries were made of many of the various works departments of cities and government departments in Canada to ascertain what specifications were used and to obtain suggestions as to desirable amendments. Replies indicate that the Canadian society specification was used in most cases, but nearly all seemed to be waiting the results of the work of the joint committee, above mentioned. Since the American specification has been published numerous communications have been received from works departments, railway companies, and others, that they concur with the findings of that committee.

Your committee, therefore, respectfully recommend the adoption of the specification as prepared by the joint committee aforesaid, subject to the alterations and additions as herein set forth.

Mr. A. D. Swan remarked that the American specifications were higher in the matter of magnesia when compared with the British specifications.

Mr. J. A. Jamieson did not agree with some of the committee's recommendations, and enquired on what basis these were made. Personally he was of opinion that they were yet far from obtaining a perfect cement.

Mr. Ross said that this was another instance of the importance of securing universal standardization.

Mr. Swan replied that the recommendation of the committee was based on the reports of 110 engineers in America.

Mr. A. Crumpton said that the American society conducted experiments from 1912 to 1916, and the result was a conclusion that magnesia with a greater percentage of 5 produced just as good results as it did with 4 per cent.

Professor E. Brown remarked that since the time the American society had changed its specifications municipal engineers had been anxious to conform with that standard. The recommendation was in order to accord with the American standard. The American society had entirely abolished the neat cement tests.

Mr. Swan said that it was questionable whether we should follow the British or American standards or adopt one which was suitable for Canada.

Mr. Jamieson was in favor of specifications which met our own requirements. He pointed out, however, that our material and methods of manufacture were the same as in the States, while there was a great deal of difference as compared with British practice.

The report was received and referred back to the council.

Sewage Disposal

Prof. P. Gillespie read the report of the Committee (Toronto branch) on Sewage Disposal, as follows:

The committee appointed by the Toronto branch re sewage disposal has held five meetings since September last, at which many questions connected with sewage disposal were discussed and considered, and at a final meeting held on January 14 it was decided to submit the following recommendations to the branch for submission to the parent society:

1. That the provincial public health acts of the different provinces should provide that two or more members of each provincial board of health shall be engineers and corporate members of the Canadian Society of Civil Engineers.

2. That the provincial public health acts should provide that all reports, plans, etc., respecting schemes for sanitation and sewage disposal required to be filed by provincial authorities shall be prepared, signed, and submitted by an engineer, a corporate member of the Canadian Society of Civil Engineers.

3. That Dominion legislation should be enacted respecting the pollution of international and inter-provincial waters, and that provincial legislation in the different provinces respecting stream pollution be made uniform as far as practicable.

4. That the public health acts of each province should give to the provincial boards of health some measure of control over the operation of municipal water purification plants and sewage disposal works.

5. That all provincial public health acts should stipulate that no municipality can submit to the votes of the electors any by-law providing for the raising of money for the con-

struction, alteration, or extension of any waterworks system or water purification works, or of any sewerage system or sewage disposal works without having had the approval of the provincial board of health, based on plans, reports, and designs submitted by engineers.

6. That the keeping of accurate and up-to-date records of all extensions and services added to sewer and waterworks systems should be required of municipalities by the provincial board of health. Where municipalities have no system of their own for keeping such records, the adoption of a method by the provincial board might be insisted upon.

7. That where provincial boards of health maintain laboratories for the investigation of problems in public sanitation, such laboratories might, under reasonable conditions, and with much advantage to the country, the engineering profession, and the boards themselves, be placed at the disposal of this society, and, through it, of its members who have problems in municipal sanitation for which they desire solutions.

The committee proposed to submit recommendations respecting rules and regulations covering the filing of plans, reports, etc., respecting waterworks systems and sewerage systems, (1) existing systems, (2) projected systems, and (3) extensions to works, but we found the time too limited for proper discussion of these important matters. We would, however, recommend that this committee be continued, and that the scope be broadened to more clearly include water supply and water purification, and problems of interest to sanitary engineers.

Prof. Gillespie asked the co-operation of the society in obtaining the reforms outlined in the report. The Toronto branch had interviewed the Provincial Secretary on the subject.

Mr. A Surveyer referred to a deputation from the society which had waited on the Quebec Board of Health and the good reception they received. The Public Health Committee of the society was of opinion that such questions should be left to each provincial division to be dealt with, so that the division could look after its own legislation.

The report of the committee was received and referred back to the council.

The Gzowski Medal

The secretary announced that the Gzowski medal had been unanimously awarded to Mr. Tye for his paper on "Canada's Railway Problem and Its Solution." The students' prize had been awarded to Mr. W. R. Way, Montreal, for his paper on "Insulated Power Cables."

There was a very large gathering on Tuesday morning to hear a paper by Mr. B. F. Haanel, chief of division of fuels and testing, Department of Mines, Ottawa, on "The Fuels of Canada." Mr. A. St. Laurent, Assistant Deputy Minister, Department of Public Works, Ottawa, presided.

The Society's Honor Roll

The unveiling of the roll of honor in the afternoon was the most impressive function which has occurred in the history of the society. Before assembling in the lobby of the building, Mr. A. St. Laurent, the chairman, remarked that no doubt many members had relatives at the front, and he was proud of the fact that his son had volunteered to go overseas. Victory and a permanent peace were the aims of those who were fighting and of those at home who were working in the great cause; and the name of the society would be well to the fore on the national honor roll.

Lieut.-Col. S. H. Hill, representing Major-General E. W. Wilson, unveiled the honor roll, which was covered by the Union Jack. Addressing a large gathering of members, he recalled the fact that the roll contained 862 names, to which another 100 ought to be added, as the society was unable to locate 200 members, half of whom were no doubt overseas. Fifty-eight members had died in action, and 65 had been decorated, including Corporal L. P. LeCointe, who had been awarded the Croix de Guerre, with a star, who was wounded, discharged, and was then present. Past President Colonel Anderson had three sons, all of whom had received the D. S. O.; Past President G. H. Duggan had had two sons killed in action; and Past President Sir John Kennedy had lost his son facing the foe. The society had a glorious record, declared Colonel Hill, who then related some of his experiences of the fine work done by the engineers at the front.

Sir John Kennedy was asked to say a few words, but he was overcome with emotion, and declared he could not say anything.

General Sir A. Bertram, in the course of a brief address, said they were met there as engineers, on a historic occasion, to pay a tribute of respect and to offer a few words of silent prayer for the gallant men who had volunteered and paid their sacrifices that the county and Empire might be free. They had lost many of their most promising young men, men who but for the war might have become prominent in their profession. "We cannot all follow their example, but it is for us, as engineers, to do our share at home, and lead the way in developing onr natural resources, improving our water-powers and railways, and in other ways ensuring that this Dominion shall become the great nation they have fought, and are fighting, to make it. To do this we must make our country strong and wealthy. The jealousies created by this war will not die out for years to come, and we all must do our share in this campaign of preparedness at home. It is for those of our profession to carry on the work with one idea in mind—God bless our men and God bless our country.

Greetings from American Society

Captain Duchastel read the following message from Mr. Charles W. Hunt, secretary of the American Society of Civil Engineers:

"Past President George H. Pegram directs me to say that, being unable to be present on the occasion of the unveiling of your honor roll to-morrow, he has used his utmost endeavors to secure the attendance of a representative speaker to express the sentiments of your American brothers. Every suitable officer has been desirous of undertaking the mission, but finds it impossible, due to important engagements which cannot be broken on short notice. It is unfortunate that our sentiments of appreciation of the glorious part the members of your society have taken in the world-struggle for right cannot be expressed in person.

"We greet you in the name of our entire membership, including 1,000 volunteer officers in uniform. We are with you in war until complete victory is achieved, and are looking forward to much closer union with our Canadian brethren after that time."

Mr. Vaughan, in moving a vote of thanks to those who had taken part in the ceremony, said that, while they felt the greatest regret at the loss of so many members who had passed away, they could not but be proud of the fine record of the society in this war.

The National Anthem concluded the ceremony.

Have Won Honors

The following is a list of the members of the society who have won honors in the war:

Capt. Robert Bickerdike, D.S.O.; Capt. John R. Cosgrove, Military Cross; Lieut.-Col. F. A. Creighton, Cross of Legion of Honor (France); Lieut. J. R. Grant, Military Cross; Lieut.-Col. C. L. S. Hertzberg, Military Cross; Lieut.-Col. J. A. Hesketh, D.S.O.; Lieut.-Col. H. J. Lamb, D.S.O.; Lieut.-Col. A. G. T. Lefevre, D.S.O.; Col. A. C. Macdonald, D.S.O.; Lieut.-Col. J. A. MacPhail, D.S.O.; Capt. H. F. Meurling, Military Cross; First Staff Officer C. H. Mitchell, D.S.O.; Lieut.-Col.

C. W. P. Ramsay, C.M.G.; Col. Karl Weatherbe, Military Cross; Lieut.-Col. F. A. Wilkin, Military Cross.

Associate members—Major J. C. Ball, D.S.O.; Major H. L. Bodwell, D.S.O.; Major J. A. Delancey, Military Cross; Lieut. H. G. Dimsdale, Military Cross; Lieut.-Col. A. E. Dubuc, C.M.G.; Capt. E. P. Fetherstonhaugh, Military Cross; E. H. Harrison, Military Cross; Capt. H. F. Hertzberg, Military Cross; Lieut.-Col. H. T. Hughes, D.S.O., C.M.G.; Major T. C. Irving, Jr., D.S.O.; Adjutant J. C. Kemp, Military Cross, D.S.O.; Lieut. L. B. Kingston, Military Cross; Lieut. L. W. Klinger, Military Cross; Brigadier-General R. G. E. Leckie, C.M.G.; Corporal P. L. P. LeCointe, Croix de Guerre; Capt. H. C. Lott, Military Cross; Major J. A. MacKenzie, D.C.M.; Flight-Commander G. G. MacLennan, Croix de Guerre; Major G. W. MacLeod, D.S.O.; Lieut.-Col. G. E. McCuaig, D.S.O.; Capt. A. P. Miller, Military Cross and Bar; Flight-Lieut. R. H. Mulock, D.S.O.; Lieut. A. C. Oxley, D.C.M.; Major K. M. Perry, DS.O.; Capt. A. B. Ritchie, Military Cross; Lieut. R. Sohier, Croix de Guerre; Major A. S. J. Taunton, D.S.O.; Major H. L. Trotter, D.S.O.

Juniors—Lieut. G. F. Anderson, Military Cross; Lieut. C. S. de Gruchy, Military Cross; Lieut. D. S. Ellis, Military Cross; Sergt.-Major C. B. Ferris, Croix de Guerre; Captain R. J. Junkin, Military Cross; Lieut. G. E. LaMothe, Military Cross; Major H. A. Lefebvre, Military Cross; Lieut. K. R. MacKinnon, Military Cross; Lieut.-Col. H. F. McDonald, D. S.O.; Major A. B. McEwen D.S.O.; Lieut. R. W. Powell, Military Cross and Bar; Lieut. J. H. Ramsay, Military Cross; Capt. R. A. Spencer, Military Cross and Bar; Lieut. F. H. Tingley, Military Cross; Lieut. G. R. Turner, Military Cross.

Students—Lieut. J. A. Creasor, Military Cross; Lieut. J. S. Galbraith, Military Cross; Lieut. G. A. Johnson, Military Cross; Lieut. A. U. Meikle, Military Cross; Lieut. W. C. Merston (Meyerstein), D.C.M. and Military Cross; Lieut. C. N. Mitchell, Jr., Military Cross; Lieut. H. R. Urie, Military Cross.

Favors Change in Name

The first business on Wednesday was the report of the scrutineers. The secretary announced that the voting on the revised by-laws resulted: For, 427; against, 13. The alteration in the name of the society to the Engineering Institute of Canada was approved by 490 votes to 109.

The following are the new officers: President, Mr. H. H. Vaughan; vice-presidents, Mr. H. E. T. Haultain, professor of mining, University of Toronto; Mr. R. F. Hayward, chief engineer and manager of the Western Canada Power Company, Vancouver. Council: District No. 1—Mr. E. Brown, professor of applied mechanics and hydraulics, McGill University, Montreal, and Mr. J. M. Robertson, consulting engineer, Montreal. District No. 2—Mr. D. H. McDougall, general manager Dominion Iron and Steel Company, Ltd., Sydney, N.S. District No. 3—Mr. Noel E. Brooks, maintenance of way engineer, C.P.R., Sherbrooke, P.Q. District No. 4—Mr. John Murphy, electrical engineer of the Department of Railways and Canals, Ottawa. District No. 5—Mr. P. Gillespie, professor of applied mechanics, University of Toronto. District No. 6—Mr. L. A. Thornton, commissioner of public utilities, Regina. District No. 6—Mr. E. G. Matheson, professor at McGill University College, Vancouver.

The New President's Address

Mr. Vaughan, on taking the chair as new president, expressed his sincere appreciation of the honor, especially as he was following so many splendid engineers. During the last two years he had been a member of the Committee on Society Affairs, and although he had not done a great deal of work on that committee, he was thoroughly in accord with their recommendations. He was now one of those who would have to put these recommendations into effect. World conditions were disturbed, and the occupations of many members had, in consequence, been changed. He believed, however, that this was a period favorable to the inauguration of the new arrangements of the society. If they put their house in order during this time of disturbance the society would reap the benefit when normal times returned. The council could only be the guiding hand. The new by-laws, of themselves, could not change the society, but the spirit of those by-laws and the alteration in the name of the society should effect a change in the society. They could see the possibility of a broad association of engineers, taking in every branch of the profession on an equality. Through the branches and provincial associations the members could represent their views to the federal and provincial governments. The council desired to secure every engineer who was eligible, no matter to what section of the profession he belonged, and the co-operation of members was desired to this end. Every distinction of rank as between all branches of the profession was done away with, and he appealed to the members to make the Engineering Institute of Canada a marked success.

Mr. J. White having announced his intention of resigning as a member of the council, Mr. A. F. Macallum suggested that the council might take action in the direction of retaining Mr. White on the council. This was left to the council.

It was decided to send a message of greeting to Mr. G. Mountain, of Ottawa.

A Branch in the Maritime Provinces

Mr. K. H. Smith, of Halifax, brought up the subject of establishing a branch in the Maritime Provinces. Personally, he regretted that during the disaster in Halifax there was no engineering organization to take any responsible share in the work. He suggested that members might be secured from the Halifax University and also from the Nova Scotia Engineering Society ,a local organization. He also pointed out that the Maritime Provinces were largely in touch with the New England States, and the establishment of a branch of the society might do something in the direction of promoting a more national Canadian spirit. Mr. Smith stated that his information was that the members of the society in the Maritime Provinces complained of a lack of cooperation on the part of the society. The time was opportune for starting a branch there, and, if possible, amalgamating with the local organization. He read a letter addressed to the secretary of the society and signed by certain engineers, suggesting a visit of the president and secretary, with a view to negotiations for this amalgamation.

Messrs. Holgate and Ross approved of the council taking up the question, the former saying that the apparent lack of interest complained of might be due to geographical conditions.

On the motion of Mr. Francis, the council will be asked to consider the subject of a badge for the society. He exhibited a proposed design, with the beaver as the predominant figure.

Mr. F. A. Dallyn, engineer of the Ontario Board of Health, offered the members of the society, on behalf of his board, the use of a sewerage laboratory in Toronto, either for research work or for working out any problems. He stated that the laboratory had, through its use by the University of Toronto, proved of great value in educating Canadians in this special branch, and also of value to municipal engineers in working out problems.

Messrs. Holgate, Gillespie, and Macallum spoke in appreciation of this offer, which will be considered by the council.

A vote of thanks to the council and officers concluded the proceedings.

On the evening of January 21 the members dined together at the University Club and afterwards held a smoking concert at the society's rooms.

General Review of Conservation Work in Canada During 1917

Report of Committee on Conservation of C. S. C. E. Recognizes That Inefficient Methods Are Making Serious Inroads on Our Resources

Stimulated by the war and conditions created thereby, Canadians are to-day recognizing in greater measure than hitherto that our resources are not as we so frequently designate them—"illimitable" or "inexhaustible." On the contrary, our wastefulness, our carelessness, and our inefficient methods have, in some instances, made such inroads upon them that all but the ignorant and unobserving can see that nothing but the practice of economic and efficient methods will permit us to hand down to our posterity an inheritance that will suffice for their needs.

Although the war has already exceeded the expectations of practically all the prophets, its termination will come, soon or late. We will then be face to face with unique conditions, with problems that the world has never, hitherto, been confronted with, and problems on such a gigantic scale that the wisest among us may well hesitate to undertake their solution. The problems must be solved, and will be solved, but not by any universal remedy, for there is no great panacea for such questions, any more than there is for all the ills to which man is subject. It behoves us, therefore, to set our house in order; each of our members should endeavor to contribute his mite toward the alleviation of post-war conditions and towards increased efficiency.

One of the outstanding achievements of the year, and one that will go far toward promoting economy and efficiency, is the elimination of the curse of patronage in the matter of appointments by the Dominion Government.

Respecting our principal natural resources a brief survey of the accomplishments of the past year will suffice.

Water-Powers

The preliminary survey of the water-powers of Canada by the Commission of Conservation has been completed, and the last of the three volumes forming this series will be published shortly. The development of hydro-electric power in Canada, particularly in Ontario, has been phenomenal. At the present time the Hydro-Electric Commission of Ontario is delivering 296,000 h.p., and still is short 70,000 h.p. There is also a shortage of power in Eastern Ontario, though upwards of 60,000 h.p. is being exported from the Cedars Rapids plant to Northern New York State. The Cedars power is used by the Aluminum Company of America in their Massena plant and in municipalities in the vicinity of Massena.

Eight years ago the Commission of Conservation actively opposed the granting to private interests of the privilege of developing power at the Long Sault Rapids of the St. Lawrence. Recently the commission has also opposed an application by private interests for permission to develop the Coteau Rapids power.

In his annual address to the Commission of Conservation, November 27, 1917, Sir Clifford Sifton referred to the Niagara Falls situation, where we are exporting 125,000 h.p., and are unable to take it away from the manufacturing and other interests in the United States. He also advocated the development of the St. Lawrence powers "by an international commission, under which the greatest and best use of the powers will be made, the most economical development will be effected, a just and equitable division of the power will take place, and the governments concerned will be able to administer the power as the Ontario Hydro-Electric Commission administers the power of Niagara for the benefit of the people who are directly concerned in its use."

This pronouncement will appeal to the engineers of Canada as a progressive, a constructive, and a statesmanlike policy.

Sir Clifford also voiced a sentiment that will doubtless receive full assent and hearty approval from the members of our society. He said:

"We are still largely dominated in Canada by the idea that any ordinary, capable amateur can do the work which ought to be done by a trained scientific man; and, until we eradicate this fallacy thoroughly, and, in its place, implant the view that men who are technically trained are the only men competent to deal with technical problems, we shall not begin to attain to general success in making the best use of the materials which are at our disposal."

In this connection an estimate of the power available from the rapids of the St. Lawrence is of interest. Mr. A. V. White, consulting engineer to the Commission of Conservation, estimates that the total maximum low-water, 24-hour horse-power is 2,395,000 h.p., and the average 24-hour, low-water horse-power is 2,150,000 h.p. The details of the estimate are given in the below table:

Water-Power on the St. Lawrence River§

Site.	Max. head available. Feet.	Max. est. low water 24 hr. h.p.	Av. est. 24 hr. low water h.p. (say).
1. Morrisburg-Rapids Plat	15	230,000	200,000
2. Long Sault Rapid	40	650,000	575,000
*3. Coteau Rapid	17	260,000	250,000
*4. Cedars Rapid‡	32	525,000	500,000
*5. Split Rock and Cascades Rapids	18	280,000	250,000
6. Lachine Rapid	30	450,000	375,000
Total		2,395,000	2,150,000

§In this table some allowances have been made for efficiency and other factors in order to have the estimates fairly representative of the possible quantities which might be expected under representative low-water flow conditions.

‡Under development for about one-third of the low-water flow of the river.

*Consideration would be given to the possibility of combining sites Nos. 3, 4, and 5; also of increasing No. 6.

Assuming an equal division of the international powers, 1,955,000 h.p. of the maximum low-water power belongs to Canada and 440,000 to the United States. If the lower figures for the average estimated power are accepted, Canada has 1,712,500 h.p. and the United States 337,500 h.p.

On the other hand, if we use the experience of the Ontario Hydro-Electric Commission as a basis, we get a diversity factor of 30 per cent., which increases Canada's resources to the equivalent of 2,541,500 h.p., and 2,226,350 h.p. for maximum and average low-water power respectively.

Although the above figures are lower than those ordinarily quoted, it must also be borne in mind that ice conditions, the excessive cost of full development, and other factors may decrease them.

The approximate maximum generation capacity authorized on the Canadian side at Niagara Falls, Ont., is 388,500 h.p., and on the United States side 265,000 h.p. Total at Niagara Falls, 653,500 h.p. Therefore, the St. Lawrence may yield from three and one-half to four times as much power as the total now authorized at Niagara.

The great conservation dam at La Loutre, on the St. Maurice River, is approaching completion. It will impound the third largest artificial reservoir in the world, being exceeded only by the Assuan dam on the Nile and Gatun Lake on the Panama Canal.

The St. Francis River dam, at the outlet of Lake St. Francis, Que., is also nearing completion. The La Loutre and St. Francis dams are being constructed by the Quebec Streams Commission. The low-water flow of the St. Maurice will be doubled and the minimum potential horse-power will be increased by 550,000 h.p. The minimum low-water flow of the St. Francis will be increased from 100 c.f.s. to 600 c.f.s.

Forests

The past year has seen important advances in forest fire prevention. In Quebec the Lower Ottawa Forest Protective Association has more than doubled the area it previously protected, and two new associations—the Laurentian and the Southern St. Lawrence—have been formed. The area now under co-operative fire protection in Quebec aggregates 45,000,000 acres.

In Ontario the provincial government has taken up fire protection on an extensive scale. In 1917 lookout towers, connected by telephone lines, were constructed; power boats, equipped with fire pumps were operated on the larger lakes, and over 1,000 fire rangers were employed.

The investigation by the Commission of Conservation of the situation respecting our pulpwood lands has disclosed the necessity for radical action if this very important resource is to yield—as it should yield—forest crops in perpetuity. As with most other resources, we have accepted at, or near, their face value the statement of lumbermen and others respecting the length of time required to produce a new crop. This statement has usually been that a new crop, equivalent to the first, could be taken off every twenty years. The investigations in the valley of the St. Maurice River, Quebec, demonstrate that, on the cut-over lands in that district, and under existing conditions, the limit-holder would have to wait fifty years, and then his crop would, probably, be less than three cords per acre, as compared with five cords per acre in the virgin forests of the same region. Dr. C. D. Howe, the investigator for the commission, sums up the situation as follows:

"The United States is thoroughly scared over its declining pulpwood supply. We are so ignorant of our own supplies that we do not know whether to be scared or not."

Provincial Survey

The Commission of Conservation has completed the inventory of the forest resources of British Columbia and Saskatchewan, and has commenced the survey of Ontario's forest wealth. Alberta and Manitoba have been fairly well covered by the Forestry Branch of the Department of the Interior. The Provincial Government of Nova Scotia has inventoried its forests, and the New Brunswick Government is surveying the forest resources of that province. In Quebec, as already stated, the provincial government has made a beginning, and the Commission of Conservation is co-operating in the examination of the Quebec pulpwood area, which, at the present time, is the most important in Canada. Quebec supplies more than one-half of the pulpwood produced in the Dominion and contains one-half of the pulp mills in Canada.

The white pine blister rust threatens with total destruction the white pine, the most valuable forest tree in Canada. This fungus lives alternately on the white pine and on the currant or gooseberry, both wild and cultivated. If either host be wanting it cannot exist. It, therefore, becomes a question which is more valuable—the white pine or the currant and gooseberry. In Quebec the disease has been discovered in five counties, and in Ontario in an area extending from the Niagara District on the west to Peterboro County on the east. The white pine of Canada has been valued at $200,000,000, and its destruction would be a national calamity.

Lands

The most important development in this connection has been the work in Dundas County, Ont., which was selected by the Commission of Conservation as an illustration county, wherein the betterment of agricultural conditions could be demonstrated. The initial step was the collection of full data respecting the farms and farm population of the county. Information respecting every phase of life on the farm, even to the nature and extent of education possessed by the farm residents, was obtained. The data thus obtained point to agricultural education and co-operation as the prime necessities if the agricultural population of the older provinces is to be kept on the farm.

Minerals

The most outstanding features respecting our minerals are the stimulation owing to the demands for war purposes and the acute fuel situation now existing in certain areas in Canada.

As one result of the war, we will have two of the largest nickel refineries in the world—one at Port Colborne, Ont., and the other near Sudbury, Ont. These plants will have initial capacities of 15,000,000 and 20,000,000 pounds of nickel respectively, and the Port Colborne plant will have an ultimate capacity of 60,000,000 pounds.

In Western Canada there is a deplorable waste of coal in connection with mining operations. In many instances the operator leaves in the mine pillars that are too small to carry the superincumbent strata, and crushing occurs. The so-called "gophering" is also carried on in some areas. A drift is driven in a few hundred feet and abandoned; another drift is driven, say, 500 feet from the first, and, in turn, is also abandoned. This operation may be repeated many times. As a result of such operations, the coal, in many instances, is rendered irrecoverable except by a shaft from the surface; but, on the other hand, the cost of sinking the shaft is often prohibitive. The so-called Frank Mine is an example of wasteful methods. Of 6,000,000 tons of coal in this mine only 24 per cent. was mined; 76 per cent. was lost.

Another example of wasteful methods is the coking of coal. At present there are in Canada approximately 1,700 beehive ovens, with an annual production of 443,460 tons, and 910 by-product ovens, with a production of 1,005,322 tons. The beehive ovens, in converting the coal into coke, waste all the valuable by-products. The derivatives of these by-products include a whole series of valuable substances, such as coal gas for heating and lighting, aniline oil, whence the aniline dyes are obtained; benzol, toluol, and other raw materials for high explosives, etc.

Fire Waste

The fire waste in Canada can only be described as appalling. Our per capita loss is greater than that of any other country in the world. In 1912-15 it was $2.96 per head, as compared with $2.26 in the United States and 71 cents for the whole of Europe. Since Confederation, Canada has suffered a direct loss from fires, other than forest fires, of $350,000,000. Adding the cost of fire protection and insurance premiums paid in excess of indemnities, gives a total of $700,000,000, which is equivalent to our gross national debt prior to the war and more than double our net debt at same date. Between August, 1914, and December, 1916, the fire loss in the United Kingdom, exclusive of fires caused by the enemy, was $41,000,395, only four-fifths of our loss, $52,027,000, although our population is only about one-sixth that of the British Isles.

Fisheries

The year 1917 should have been a so-called "big year" for sockeye salmon on the Fraser River. Unfortunately, there was an immense rock-slide from the Canadian Northern grade in 1912, which converted a very swift current into a fall that the salmon could not ascend the following year. As 1913 was a "big" year, this barrier prevented enormous numbers of salmon ascending the Fraser to spawn. The fish struggled till exhausted and then died, vast numbers being found on the bars of the Fraser, between Yale and Agassiz.

The results are little short of a calamity. Not only was the run of 1917—which should have been a big year—nearly destroyed, but the disastrous effect will be repeated upon the run of 1921 and of succeeding "big" years, unless the governments of Canada and the United States take united and drastic action to restore this valuable fishery.

The loss in 1917 to the fishermen of British Columbia was upwards of $8,000,000, and to the fishermen of the State of Washington $19,500,000, or a total loss of $27,500,000. In 1913 the British Columbia pack of sockeye was 719,796 cases; in 1917 it was only 32,146 cases. In 1913 the State of Washington pack was 1,673,099 cases, as compared with only 84,637 in 1917. In other words, the 1917 pack, instead of being approximately the same, was only one-twentieth of the 1913 pack.

Game

In 1916 Great Britain and the United States concluded a treaty providing for the protection of migratory game and insectivorous birds. In 1917 the Parliament of Canada passed enabling legislation to give effect to the treaty. Parliament also passed a new Northwest game act, providing for the protection of game in the Northwest Territories.

This legislation will protect a large portion of our wild life which was threatened with extinction in the case of some species and the excessive depletion of others.

Additional Data

In addition to the data incorporated in the general report of the committee, the following members have made special recommendations:

Mr. E. T. P. Shewen writes:

"For nearly a quarter of a century I have been endeavoring to awaken attention to the importance of commencing on an adequate scale the distillation of domestic coal, and that is still my theme.

"One ton of ordinary coal produces 10,000 cubic feet illuminating gas, ½ ton coke (according to Dr. Haanel, more), 12 gallons coal tar, ammoniacal water; and, on being distilled, the tar yields 1½ gallons light oil, from which are made aniline dyes, chemicals, etc., 3 gallons creosote, 6 to 8 gallons of pitch (the residue).

"Dr. Haanel, in 'Products and By-Products of Coal,' rather discourages the further treatment of the light oils in saying that the market for dyes is small, while he appears to throw some doubt upon the profitable recovery in Canada of the by-products of coal in general.

"But the manufacture of dyes and chemicals from the light oils might be carried on here just as well as it has been done in Germany, provided the urgency of the undertaking is recognized, and Canadians are sent to England or Scotland to receive the necessary special training in the chemistry of coal and the practical method of managing the manufacture of the by-products, as far as it is carried on in Britain.

"I have recently pointed this out to the Industrial Commission, of which Sir George Foster is the head, in response to their circular sent to departmental officers.

"At the same time, I suggested that the utilization of the light oils might be left in abeyance for the present, until these men had received the required training; and that, meanwhile, the distillation of tar in Canada might proceed for the sake of the creosote and pitch. Of course, the coking of the coal would be a condition precedent.

"We need creosote in quantities for treating the timber from which so many of the public works are built, in order to preserve everywhere that material from decay above water, and on the coasts from the teredo and limmoria below water-level. The United States does not produce sufficient creosote for home consumption, and we cannot obtain any from that quarter. In fact, a good deal of London oil is imported, or was imported until lately, to America.

"For shipbuilding, for roofing, and for many other purposes pitch is in demand.

"Where steam is used coke is in demand as fuel. Perhaps if put to it, sanitary engineers might devise a fireplate and furnace that would render coke as satisfactory as coal for house use.

"As a strict matter of conservation, I do not think that coal in the natural state, being the most valuable raw material we possess, should be consumed as fuel; but should only be burnt in order to save the by-products, the coke being used for fuel in place of coal."

Mr. William McNab suggested that:

"One feature of our report might be the consideration of the specific interest to railways involved in their relation to the several important conservation projects, ascertaining what has been done by them up to the present time in regard thereto, and then particularize and recommend on policies economical for them to follow. I submit this as a suggestion."

Town Planning in Ontario

Mr. W. H. Breithaupt reported as follows:

"There is to report this year, as to town planning, that the Ontario Government enacted at its last session a town planning law, entitled 'An Act Respecting Surveys and Plans of Land in or Near Urban Municipalities,' which is a beginning in the right direction.

"This act provides for street planning, new extensions, or widening; for bringing adjacent territory under urban authority, and for a central provincial authority, the existing Railway and Municipal Board. The local authority is either the municipal council or the town planning commission. Appointment of a commission is optional with the council, but once appointed the commission is the local authority. The commission consists of the head of the municipality and six ratepayers, the term of office being three years. Members of the first commission are appointed for one, two, and three years respectively. With only two new appointees each year, the commission is a continuing body.

"While a commission appointed under this act has considerable scope for beneficial work, it is felt that provision for carrying out plans, and especially provision for adjustments in land condemnations and sundry other powers, would greatly add to its capacity for general benefit.

"Only one commission, that of the city of Kitchener, has so far been appointed under the act. The Kitchener commission has regular monthly sessions, and has made a fair beginning in the work of opening closed-off areas in the older parts of the city and in projecting long-needed connecting streets."

Mr. C. R. Coutlee wrote:

"It only remains to repeat former suggestions respecting forest protection and the prohibition of placing settlers on granite soils.

"A desirable matter is also the handing over of provincial interests on rivers of 20,000 square miles drainage areas and sufficient flow to the federal government. This is with a view to ideal development of water-power at public expense."

In accordance with the resolution of January 23 last, the Committee on Conservation was reduced by council from 22 members to 11—W. H. Breithaupt J. B. Challies, C. R. Coutlee, C. E. W. Dodwell, Lieut.-Col. R. W. Leonard, R. McColl, William McNab, Lieut.-Col. C. H. Mitchell, P. M. Sauder, E. T. P. Shewen, James White (chairman).

Some debate as to whether the council should be asked to continue a committee followed, and it was decided to request the appointment of a committee.

Fuel Requirements and Resources of Canada

Mr. B. F. Haanel's Paper Before Canadian Society of Civil Engineers Gives Practical Data on a Question of Timely Importance

If the violent rupture of the peaceful conditions existing some four years ago had not occurred, it is very doubtful whether the subject of fuels would attract any special attention to-day, unless, perhaps, a discussion of such a subject disclosed new fields for profitable exploitation. To-day, however, the attention of the people of this country is forcibly centered on this very subject, because we are realizing, perhaps for the first time, our dependence, to so large an extent, on the United States for this essential commodity; and, further, are beginning to understand that our supply of fuels from that country may be cut off at any time.

In the past, and up to the present, we have been depending largely on fuels mined and prepared for the market by labor over which we have absolutely no control. As a consequence, we are at the mercy of foreign strikes and industrial disorganization, and either one or both of these are liable to occur.

A strike of coal miners, or a railroad strike, in the United States would affect Canada more seriously in certain respects than the States, since in Canada we would not have the advantage of accumulated reserves which the United States would be certain to have in normal times.

But there is even a more important factor which we must consider, viz., the necessity which may occur for the United States to keep her fuels within her own country. Such a situation may not arise for some time, but the indications are that we may have to meet such an emergency in the near future.

Canada to-day is facing a fuel situation of great gravity; a situation which has not been created by any special conditions in this country, but by those obtaining in the neighboring country. The United States is suffering from a shortage of fuels as a result of the withdrawal of skilled labor from the coal mines to other occupations, and, perhaps more directly, to the abnormal demand on the transportation facilities of that country for the carrying of material directly connected with the conduct of the war.

We are not wholly dependent on the United States for our fuel supply, but we are dependent to the extent of 55 per cent. of our total coal requirements and 98½ per cent. of our crude and refined oil products. Large and important sections of Canada, moreover, are almost wholly dependent on imported coal for house-heating purposes. This is a matter for grave reflection, since in a country such as ours, where artificial heat must be supplied during eight months of the year for the sole purpose of maintaining life, a continuous and dependable supply of fuel is absolutely essential.

The fuel situation existing in Canada to-day is due to the ease with which fuels of all kinds, suitable for every requirement, were imported from the United States, and to the apathy displayed towards the exploitation of certain of our own fuel resources by the public at large.

We have not exploited our fuel resources, with the exception of wood, on an extravagant scale; but, on the contrary, we have been culpably neglectful of these vast sores of energy, in so far as we have failed to provide for the future by learning how to use our low-grade fuels, on which at no distant time we shall have to depend. The result of this neglect to improve our position and render ourselves independent, as far as possible, will be great suffering to the people of Canada, in the event of a stoppage of fuel supplies from the United States, if we do not, at once, take steps to render our own fuel resources available for our own needs.

The present unsatisfactory—indeed, alarming—situation can only be improved by a determined and energetic exploitation and utilization of our own vast fuel resources.

I am prepared to show that Canada does possess abundant supplies of fuels, favorably situated, and that these can be exploited in such a manner as to render her much less dependent on, if not entirely independent of, foreign sources for her fuel supply.

Before enquiring into our fuel possibilities it is necessary to state and analyze our annual fuel requirements.

Canada's Fuel Requirements

The total fuel requirements of this country during the year 1916 amounted to nearly 30,000,000 tons of coal, 299,426,121 imperial gallons of crude and refined oil products, and firewood valued approximately at $60,000,000.

The railways burned 9,000,000 tons of bituminous coal; 7,000,000 tons were probably required for the purpose of generating power, and a large quantity was used for making retort or town gas, heating large buildings, and the manufacture of coke. Over 4,000,000 tons of anthracite were burned in domestic and other heating plants, and, to some extent, were used for industrial purposes. In normal times practically the entire imports of anthracite coal are used for heating purposes.

Compared with her annual requirements, Canada's production of fuels for the same period amounted to 14,483,395 tons of bituminous coal, of which 2,135,359 tons were exported; 6,934,288 imperial gallons of crude oil, and wood fuel to the value of $60,000,000. To meet our own needs, therefore, it was necessary to import 17,580,603 tons of coal and 292,426,121 imperial gallons of crude and refined oil products.

Of this quantity of oil approximately 50,000,000 gallons were used on the railroads, 30,000,000 gallons for steamships, and the remainder, 210,000,000 gallons, was used for lighting and heating, in the form of kerosene and, to a large extent, in the form of gasoline, for power purposes.

This is a general statement of the extent of our dependency on the United States for these essential commodities.

An analysis of our fuel resources, their location and extent, will reveal the reason for the necessity of these excessive imports.

The Fuel Resources of Canada

The fuel resources of Canada exist in the vast coal fields of the extreme eastern and western portions of Canada; the lignite fields of the Western provinces; the natural gas fields of Western Canada and the Province of Ontario; the petroleum fields of Ontario; the oil shales of New Brunswick, Nova Scotia, and elsewhere; the standing forests, and, last, but not by any means the least important, the great areas of peat bogs. This is a truly formidable array of resources. Now, let us enquire into their extent, quality, and location, since these are the most important factors concerning their exploitation.

The following is an estimate of the actual coal reserves of Canada, based on actual thickness and known extent. The location and approximate classification of the coals are also designated:

Nova Scotia—2,137,000,000 tons of bituminous coal and 50,000,000 tons of cannel coal.

Saskatchewan—2,412,000,000 tons of lignite.

Alberta—382,500,000,000 tons of lignitic or sub-bituminous coal, 1,197,000,000 tons of low carbon bituminous coal, 2,026,000,000 tons of anthracite and bituminous coal, 669,000,000 tons of semi-anthracite coal.

British Columbia—23,653,000,000 tons of semi-anthracite and bituminous coal, 118,000,000 tons of low carbon bituminous coal, and 60,000,000 tons of lignite.

In addition to these admittedly great coal reserves, we have in this country 37,000 square miles covered with peat bogs. The total estimated tonnage of fuel represented in this area is 28,000,000,000 tons of 25 per cent. moisture peat fuel, equivalent, on the basis of actual heating value, to about 16,000,000,000 tons of good coal. Of this total area, however, only a portion is favorably situated with respect to economic development. Twelve thousand square miles of peat bogs are distributed throughout the central provinces—Manitoba, Ontario, Quebec, and New Brunswick—and the estimated tonnage of peat in this area is 16,000,000,000 tons, equivalent, on the basis of actual heating value, to 9,000,000,000 tons of coal.

No estimate can be made of the forests of Canada which are available for firewood, and natural gas has a special value only in those districts which can be economically served with this fuel. Natural gas is of great value when it can be obtained in large quantities in well-populated and industrial communities, but it possesses the disadvantage of being an uncertain source of heat.

Of petroleum all that I shall say, at the present time, is that Canada is manifestly not a petroleum-producing country.

The principal fuel resources, then, which we have to consider are the bituminous and anthracite coal, the lignites, and peat. Oil shales and other sources of oils will be considered later.

The statement of the distribution of our fuel resources discloses the fact that the true coals are situated in the extreme east and west, and the western part of Alberta; the lignite coals are situated in the Provinces of Alberta and Saskatchewan, but lying between the limits of these deposits is a great stretch of territory devoid of coal measure of economic value. The 12,000 square miles of peat bogs are situated in this area.

Natural Divisions of Country and Their Coal Resources

The country naturally lends itself to a division into four parts or districts, and each district has an abundance of fuel peculiar to its own area. The first district embraces that portion of Western Canada which can be economically supplied with bituminous and anthracite coals; the second district, that area which can be supplied with lignite; the fourth area, that portion of Canada which can enjoy the full advantages of Nova Scotia coal. The third district cannot be economically supplied with any of the above coals. This area must either render itself independent of foreign fuel sources by developing and utilizing its excellent peat bogs or remain, to a large extent, dependent on the United States. A large portion of the Province of Ontario is principally affected in this manner.

To supply certain of these areas with fuel of the desired quantity and of a quality suitable for various purposes constitutes a problem which must be satisfactorily solved before we can improve our fuel situation.

The bituminous coals of Canada are similar to those of the United States, and include large quantities of excellent coking coal. Their utilization for general industrial purposes presents no difficulties whatever, but for domestic purposes bituminous coal, in its raw state, is far inferior to anthracite, which is the fuel almost entirely used for this purpose in Canada. A most excellent fuel, practically the equal of anthracite, can, however, be produced from bituminous coal by a special process, consisting of carbonization at low temperature and briquetting. This process is in actual operation today, turning out briquettes of this description, entirely satisfactory for domestic purposes.

With lignite and peat, however, the situation is totally different. In their raw state, peat and a large portion of the lignite are not suitable for use. These fuels must be submitted to some preliminary treatment before they can be utilized for general fuel purposes.

When the peat deposits of the central provinces and the lignites of Saskatchewan and Alberta are rendered into forms convenient and suitable for domestic and industrial purposes, the fuel situation, so far as Canada is concerned, will have been greatly improved.

Before treating these two fuels in detail it is necessary to draw your attention to the fact that the transcontinental railways traversing the Western provinces are prohibited by an order of the Railway Commission from burning lignite in the locomotives during the summer months. These railways, on their westbound trips, are consequently compelled to burn imported coal to that point in the Western coal fields where they can again replenish their tenders with native bituminous coal. The same thing takes place on that portion of the eastbound trip traversing the Province of Ontario.

Apart from this order issued by the Railway Commission, the railways would much prefer to haul and burn imported coal, inasmuch as lignites—at least, certain of them—are not suitable for locomotive use.

The railways of Ontario also are entirely dependent of imported coal.

Preparation of Lignite and Peat for Economic Utilization

The utilization of certain of the lignites for some purposes is possible without any subsequent treatment. With others, however, notably those of Saskatchewan, the lignites as mined as not suitable for use. This is due to the physical and chemical properties peculiar to this type of fuel.

Lignites usually contain large quantities of moisture, ranging from 16 to 35 per cent. of the weight of the fuel, and the evaporation of this moisture, whether by natural or artificial agencies, results in the disintegration of the fuel. This disintegration, however, does not discontinue when the evaporation of the moisture is complete, but appears to go on indefinitely.

One more peculiarity must be mentioned, viz., the dangerous sparks emitted from the stacks of locomotives when lignite is burned. These sparks, when they emerge from the stack, burn with a small flame, and this flame is not extinguished by its passage through the air, as is the case with bituminous coal or anthracite coal sparks, but continues to burn after lighting on the ground. On account of this dangerous property, lignites cannot be safely burned in locomotives.

Lignite, unlike the true coals—bituminous and anthracite—lacks definite structure. (This term is employed in its physical sense.) To this may be attributed the reason for the difficulty with which lignites submit to mechanical treatment.

The characteristics of lignites must be altered before they can be converted into a satisfactory fuel. Experiments on a commercial scale have demonstrated beyond doubt the fact that our lignites cannot be briquetted in the raw state with or without the addition of a binder. Briquettes made in this manner appear on casual examination, to be entirely satisfactory, but when submitted to a water test, or when burned, they will invariably disintegrate.

The characteristics of a lignite are changed by carbonizing it at low temperature. During this process the moisture and volatile matter are completely distilled off and there remains in the retort a residue composed of practically pure carbon. This residue is then mixed with a suitable binder and briquetted. In order to render this briquette waterproof a second heat treatment, or baking, is necessary. A fuel entirely satisfactory in every way—waterproof, capable of resisting disintegration when exposed to the weather, standing rough handling without breaking, not emitting flaming sparks, and capable of maintaining its physical structure or shape under the action of heat until completely consumed—has been produced by such a process. In order to demonstrate that this process will solve the problem in connection with our Western lignites it is advisable to erect a commercial plant capable of producing one or two hundred tons of lignite briquettes per day. Such a plant would have to be equipped in such a manner as to allow of a certain amount of experimental work being performed, e.g., in connection with binders.

I am of the opinion that it would require only a comparatively small amount of money, i.e., compared with the immense value which the solution of this vitally important problem would be to the country, to successfully demonstrate that the lignites of the West could, by means of such a process, be converted into a fuel entirely satisfactory for domestic and industrial purposes.

The establishment of briquetting plants at strategic points throughout the lignite provinces of the West would very greatly help in reducing our dependency for fuels on other sources. While a domestic fuel is, of course, of first importance, lignite briquetting industries would prove also of great value to the railways traversing the lignite belts. It would even be within the realm of possibility to economically supply at least a portion of the Province of Ontario with this class of fuel.

The only remaining low-grade fuel to consider is peat.

Peat Fuel

The exploitation of our peat resources for the manufacture of a fuel does not involve any research work or experimentation. An economic process for the manufacture of raw peat into an excellent fuel suitable for domestic and, to some extent, industrial purposes, is in use to-day, and has been employed for many years in the peat-using countries of Europe. There is a flourishing and extensive peat industry in several of the European countries, but in Canada, a country possessed of magnificent peat resources, and dependent to so large an extent on foreign supplies of coal, no peat industry exists. This deplorable state of affairs is due to misdirected energy in connection with the many attempts made to manufacture a fuel from peat and to a general lack of interest towards anything connected with "peat" by the influential men of Canada.

Whether or not a particular natural substance shall be exploited has usually been decided from a "profit" point of view. Peat, not holding out great prospects for fabulous profits, failed to attract the attention of the large capitalists and industrial men. The creation of a peat industry was, therefore, left to the mercy of a few earnest and honest men with insufficient capital to prosecute an undertaking of this kind to a successful issue, and to a few fakirs and otherwise unscrupulous promoters, whose sole aim and purpose was "to get away with the money" before being discovered. Without going into detail, it will suffice to say that several attempts have been made, and as many failures, with loss of capital involved, have been recorded; but the larger portion of the capital lost could have been saved and a flourishing peat industry long ago established if the promoters had been advised by accredited engineers who understood their business. Instead, however, of profiting by the experience of European investigators—gained at great expense—money was expended in developing and trying out ideas which had long before been discarded as impracticable, and, in many cases, impossible, by the investigators and engineers of the peat-using countries of Europe. Not until the results of the investigations conducted by the Mines Branch of the Department of Mines concerning the economic methods employed for the manufacture of peat fuel in European countries were placed at the disposal of the public were men with impractical ideas dissuaded from interesting people in their schemes. Men of this description are still found going from place to place in a vain endeavor to interest capital, but they are rapidly disappearing.

Not until the utilization of a natural substance is forced by absolute necessity will the most sincere and earnest efforts be put forth to successfully and economically convert it into a usable product. It appears to me that the time is at hand when necessity will decide that we Canadians utilize our peat resources, and in the most efficient manner.

Peat, in its natural state, is generally associated with about nine times its weight of water. It is, therefore, evident that 1,800 pounds of water must be removed in order to recover 200 pounds of solid matter. Moreover, this solid matter not only represents the combustible substance, but also the ash and mineral matter which is associated with peat.

The separation of this large quantity of water and the handling of so large a quantity of raw peat substance, in order to obtain a comparatively small quantity of combustible matter, represent the difficulties with which we are confronted when an attempt is made to manufacture peat into a fuel, on a commercial basis, and in a thoroughly economic manner.

The only economic process in existence to-day is that which employs the forces of Nature—the sun and the wind—for the removal of the moisture. The process employing these forces is called the "wet process," and the product obtained is termed "machine peat." This is the process which the Mines Branch, Department of Mines, demonstrated at the government peat plant at Alfred, Ont.

We not only have the process for manufacturing peat fuel, but also sufficient detailed information concerning peat bogs of immediate importance to make a good start in the formation of a peat industry.

During the period covering the past ten years the Mines Branch has completely investigated and mapped 58 Canadian bogs, all of which are situated conveniently with respect to inhabited and industrial communities, and also well situated with respect to railway and other transportation facilities. The investigations are conducted with a view to determining the principal and controlling characteristics of a bog, viz., its area, depth, quality at different depths, quantity in tons, and, in general, its suitability for any particular purpose. The area examined in detail comprises 170,000 acres, and represents a quantity of standard peat fuel, i.e., fuel containing 25 per cent. moisture, estimated at 120,000,000 tons. Seven bogs conveniently situated with respect to Toronto could supply that city with 26,500,000 tons of fuel, and seven bogs in easy reach of Montreal could supply 23,500,000 tons of fuel. Excellent bogs are, likewise, conveniently situated with respect to thickly inhabited communities in Nova Scotia, New Brunswick, and other parts of Canada. This completes our inventory of the solid fuels. In regard to oil we are not so favorably situated.

Economic Utilization of Our Fuels

I desire now to deal with the methods to be employed for the utilization of fuels in general, in order to convert the maximum of their heat energy into usable forms of energy, and to recover the maximum of the valuable chemical compounds which can be obtained from the solid fuels.

All of the solid fuels contain the element nitrogen, some to a very large extent, and this is the basic element of a most important chemical compound—ammonium sulphate. In normal times this substance is used very extensively for agricultural purposes, in order to restore to the exhausted wheat fields and other agricultural lands the essential nitrogen which has been removed, almost to exhaustion in certain instances, by the repeated raising of the same crops.

The necessity for employing such a fertilizer on our Western wheat fields may not be apparent to everyone, because of the large increase in our wheat production from year to year. This is directly due to the large crops realized from the new, virgin fields which are put under cultivation each year. The average yield per acre of the older wheat fields, however, is rapidly decreasing, and if their production is to be maintained or increased, an artificial fertilizer will have to be employed.

This fertilizer is, however, in great demand in other countries, and its recovery in Canada and sale to other countries would, in many cases, prove to be a profitable venture.

The solid fuels are burned on a large and continually increasing scale for the production of power, town or retort gas, for the manufacture of metallurgical coke, and for general heating purposes.

By-Product Coke Ovens Receiving Greater Use

The employment of the by-product recovery coke oven for the manufacture of metallurgical coke is taking place on a large and rapidly increasing scale in the United States, and Canada is now employing such ovens to a considerable extent. The manufacture of coke in by-product ovens is attended with the recovery of ammonia and the oils previously referred to. The entire quantity of coal used for coke and gas-making should be utilized according to this method.

Power, other than hydro-electric, can be produced from the solid fuels in two principal ways—through the media of, first, the steam generator and steam engine; second, the gas producer and gas engine.

When the energy of coal is converted into useful work by the first method all valuable by-products are forever lost. When the second method is employed, and the producer is of the by-product-recovery type, it is possible to realize a maximum recovery of the nitrogen content of the fuel. The thermal efficiency obtainable with the latter is also considerably higher than can be realized with the steam power plant.

The producer gas by-product recovery plant is eminently suitable for the production of a power and industrial gas, and the field of its application might be extended to include the supply of gas for certain domestic purposes, e.g., general heating. Such a gas possesses the advantage of low cost, inas much as the plant can be situated at or near the source of fuel. Moreover, the cost of operating the plant can be appreciably reduced through the sale of the by-products, and this results in a further reduction of the cost of the gas per 1,000 cubic feet, if the production of gas is the main purpose.

We, however, possess sources of fuels especially high in nitrogen, viz., the peat bogs. The average nitrogen content of all the peat bogs so far examined is high, but there are a few notable peat bogs of large extent, containing fuel of excellent quality, in which the nitrogen content is very high. The fuel of such bogs should unquestionably be utilized in by-product recovery producer gas plants, for the production of power or a power, industrial, and domestic gas. The bogs referred to and described in detail in Mines Branch Report 299 are favorably situated with regard to populated communities and industrial centres.

Some of our fuels are especially valuable for purposes for which no other fuel can be substituted. This is especially the case in the coking variety of bituminous coals, and these fuels, at the present time, are being used indiscriminately for all purposes, notwithstanding the fact that the coking coals are invaluable for many metallurgical purposes and cannot be replaced, by any means known to-day, with non-coking coal. A coking coal should, therefore, never be used for any purpose for which a non-coking coal will be entirely suitable.

The quantity of coke produced in Canada to-day is small, and the necessity for conserving this class of coal may not be apparent. The great demand, however, for metallurgical coke in the United States and the probable depletion in the not far distant future of the supplies of this fuel in that country will, in time, make our deposits of coking coal of special value. When that time arrives, we shall have an excellent commodity for purposes of barter, if we now take steps to conserve our supplies.

The problems associated with the distribution of fuel to the various parts of Canada are somewhat complicated, owing to the distribution of its population. In order to supply heat and power in the most economical manner and at the lowest cost to a population so widely scattered the most rigid economy must be installed. The added cost to a fuel consequent on large rail haulage and local distribution can be very materially reduced by centralizing heating and power plants.

The populated sections of the country should be carefully studied with a view to its logical division into sections, each of which could be economically supplied with heat and power by one central heating or power plant. If this were carefully followed out, very marked economy would result in both the use of the fuel and its cost to consumer. The difficulties entailed in the distribution of the required fuel for such communities would, at the same time, be very largely overcome.

Many of our industrial plants have been located without any regard to the source of power or fuel on which they depend. Such industries, wherever it is possible to do so, should be moved to a locality which can be economically served with hydro-electric energy or electric energy generated in a large central plant, and industrial sites in general should be set aside for the location of all future industries.

Must Practise Conservation

It is evident that our fuels cannot be used indiscriminately and without the exercise of some degree of intelligence. We must not only meet all our own fuel requiremnts and place the people of this country in such a position that they will not need to worry about a possible coal famine, but we must, at the same time, utilize our fuels in the most advantageous and economic manner. Great as our fuel sources are, we must practise conservation. Only by doing this do nations become strong and powerful.

The fuel situation of Canada, as I view it, is not a gloomy or discouraging one, for we are endowed with fuel deposits on a magnificent scale. All that is necessary now is that their proper exploitation and economic use be assured.

It will, therefore, be the duty of the engineering societies represented by your society and others to produce the necessary and unremitting pressure upon the proper authorities to give effect to your recommendations for the betterment of our fuel situation, so that Canada may be, for years to come, relieved from the ever-recurring anxiety of where the next year's fuel supply is to come from.

You can readily understand that the task before you, as engineers, is a difficult one, but one of the greatest possible importance, for the habitability of certain now populated sections of Canada depend upon the success of your efforts.

Discussion

The paper was followed by a very spirited discussion, which was particularly timely in view of the general fuel situation on the continent.

Mr. A. H. Harkness thought the paper was an admirable one. He recalled the use of peat briquettes in locomotives and its great utility in the locomotives of those days. The question of by-products was very pressing, and he strongly advocated the installation of necessary power plants at the source of fuel.

Mr. R. A. Ross reminded the members of the world-wide scarcity of fuel, and said that generally the public did not realize how civilization depended upon energy. Only 10 per cent. of the coal used in the United States and 13 per cent. in Canada was for domestic purposes, and the rest was for power production. We ought to very seriously consider Canadian resources of energy, not only from coal, but also from water-powers. Mr. Ross then outlined, on a map, the resources of power, geographically considered, and also the points of distribution. Apart from districts in the West served by the West and districts in the East served by the East, there was an area of 1,500 miles dependent upon United States coal. His own idea was that each area ought to be considered by itself, having regard to the supplies of power, either in the form of coal or of water-power, or in combination. It was a question of engineering. Up to the present the way in which matters had been dealt with resulted in simple chaos; it was a mere patchwork. The Dominion Government had alienated water-powers and coal fields, and the provincial governments had done the same. The various governments had a mass of information on this subject, embalmed in green covers and put on the shelves. It was up to the society to help the government in the matter and also to help themselves.

Utilizing Western Lignite Resources

Mr. Ross then referred to the efforts of the Advisory Council for Scientific and Industrial Research in the direction of utilizing the lignite resources of Saskatchewan. The proposal was for the federal government to instal a plant with a view to converting lignite into briquettes on a commercial basis for domestic fuel; but so far the government had not done anything in the way of financial assistance. In this connection he drew attention to Mr. Haanel's address, in which the engineering societies were advised to bring unremitting pressure on the proper authorities. There was, indeed, urgent necessity for action to stir up the authorities. How could it be done? He suggested the appointment of a ministry of power and fuels, who could take up the problem, having the necessary administrative and executive powers, or the situation might be dealt with by a combined commission of the federal and provincial governments. But the society should get action, as the time was now ripe for it.

Mr. Francis moved, and Mr. E. Marceau seconded, "that this meeting recommends to the council the appointment of a committee to make representations to the government regarding the advantages and benefits of a proper and systematic development of our fuel resources in conjunction with the development of new water-powers, to the end that the most advantageous combined use may be made of these natural resources of Canada."

Mr. J. B. Challies related the steps taken by the Dominion Government which resulted in the map used by Mr. Ross being prepared. The water-power situation, he was afraid, was not properly appreciated by members of the society. The federal government controlled the water-powers in the West, while the provincial governments controlled those in the East, and the former had now under consideration the question of co-ordinating the various powers and placing under one head various administrative organizations.

Col. W. P. Anderson observed that the question was really financial, while the subject of distribution of fuel must not be overlooked.

Mr. White prophesied that unless the war were speedily ended the fuel position in Canada next winter would be very grave. He told of the steps taken by the Conservation Commission to obtain in Ontario an ample supply of wood for next year.

General Sir A. Bertram spoke of the difficulty of getting government officials to move in the matter, and Mr. W. J. Dick gave details of the location of fuel in Canada, and also referred to the use of peat and powdered coal.

Replying to a suggestion by Mr. Kerry, that the committee should confine its work to the technical side, Mr. Ross declared that the committee should deal with the question in a broad spirit.

The discussion was continued in the afternoon by Mr. Vaughan, who was of opinion that no good could be accomplished unless the committee made definite proposals to the government. He was sceptical as to whether business men would take up the development of lignite on results based on a government experimental plant. If the government undertook the control of the business it would be a reversal of the general policy of allowing private enterprise to exploit such resources.

Mr. Ross was not satisfied with the fuel position to-day, and he was afraid it would become worse, forcing the government to action. It was not possible to get private interests to put money into, say, a lignite industry while it was in the laboratory stage. He did ask for the backing of the technical men of Canada in order to tackle this question.

Mr. Francis remarked that the appointment of the committee was to study the subject, which was really one of engineering. It was a question of economics, and economics were part of engineering practice.

Mr. Jamieson and Mr. Motley also spoke, the latter relating his experience of heating his home with electricity.

The motion was carried.

Manufacture of Steel from Sudbury Ores Reported to C. S. C. E.

Lieut.-Col. R. W. Leonard read a report descriptive of some tests carried out at the plant of the Canada Cement Company, Montreal, on a process for making steel direct from Sudbury ores. Col. Leonard also described the process of making the steel (in which the Nickel-Copper Steel Corporation is interested), and stated that a high-grade alloy steel was being made from ores containing iron, nickel, and copper. The report claimed certain advantages for the steel, one being that it was practically entirely made from Canadian materials. It had passed certain British Government tests, and was also being used commercially to a limited degree.

Officers of Quebec Association of Architects

The Province of Quebec Association of Architects held their annual meeting at Quebec on January 19th, when the following officers were elected: President, Mr. J. A. Monette; first vice-president, Mr. J. A. LeBon; second vice-president, Mr. D. Norman McVicar; secretary, Mr. J. Emile Vanier; treasurer, Mr. D. M. Miller. The following members of the Council were also elected for the present year: Messrs. U. J. Asselin, A. Beaugrand-Champagne, Herbert Raine, G. R. Macdonald, and L. A. Auger. The reports of the Council and of the treasurer were read and approved.

A special committee was appointed to meet a delegation from the Board of Control, of Montreal, to discuss, at the request of the latter body, various matters of mutual interest. A special delegation was also appointed to interview the city of Montreal Legislative Committee, with a view to passing and putting into force the draft of the new building by-laws which has been for a long period in abeyance.

The regular meeting of the Manitoba branch of the Canadian Society of Civil Engineers was held in the engineering building of the University of Manitoba on January 21. An interesting paper was read by Mr. J. F. Greene on the durability of concrete in prairie soils.

Rattler Tests for Shallow Paving Brick

What Allowance Must Be Made in Rattler Requirements To Correctly Gauge Quality of Three-Inch Blocks?

IT is very important to have a definite, universally accepted method of testing any paving material. Paving engineers in their specifications call for a certain grade of material—one designed to withstand expected conditions of traffic and loading—and it is necessary that they have some standard method of determining if they are obtaining what they call for and that for which the taxpayers spend their money. In a paper presented before the American Association for the Advancement of Science, William C. Perkins, chief engineer of the Dunn Wire-Cut Lug Brick Company, discusses the rattler test as applied to paving brick, with particular reference to the needs of some adjustment of the test regulations as to apply more correctly to 3 in. brick. The paper follows:

Many methods have been devised for the testing of paving brick. Tests formerly employed, as, for instance, for specific gravity, crushing strength, percentage of absorption, etc., have been practically abandoned.

The main test now is for abrasion and impact, and it is generally called the "rattler" test. This exceeds in importance all other tests combined; in fact, if a paving brick passes a satisfactory rattler test, it should be able to pass any and all of the other tests.

The present standard rattler is a development of the old foundry rattler, and in the old days the bricks and scrap iron were tumbled in a revolving barrel, such as is found in many foundries, and thus, in a crude way, was obtained a comparison of different makes of paving brick.

Standardized Rattler

The first attempt to standardize the rattler was made by Professor Ira C. Baker, about 1890. Later Professor Edward Orton, Jr., in conjunction with the National Brick Manufacturers' Association, made a series of experiments, and, as the result of these experiments, a standard method of testing paving brick by the rattler was adopted in 1897. This was only a beginning, and further experiments were made by Professor Talbot of the University of Illinois, principally along the lines of the composition and shape of the abrasive charge. In 1901 the National Brick Manufacturers' Association recommended the adoption of a standard rattler, using an abrasive charge of 300 pounds of ordinary machinery cast iron. This charge consisted of 225 pounds of 1½ inch cubes, with square corners and edges, each weighing about seven-eighths of a pound, and 75 pounds of rectangular prisms, 2½ inches square by 4½ inches long, with their edges rounded, weighing about 7½ pounds each. A standard method of making the test and standard methods of calculating the results and making the records were devised, and this rattler was generally adopted by paving engineers.

While this rattler gave fairly good results, it was observed that its efficiency was impaired and variable results were caused by seemingly unimportant details, such as the condition and stiffness of the staves of the barrel, the chemical composition of the cast iron of the abrasive charge, the number of times the rattle was used without changing the staves or the abrasive charge, the number of rotations of the rattler, and the method of driving it, etc. Efforts were made to correct these variations, and in 1910-11 the National Paving Brick Manufacturers' Association and Professor Edward Orton, Jr., made another extended series of tests and devised specifications, which gave in much detail the method of construction of the rattler, the method of driving it, the shape, size, weight, and chemical composition of the abrasive charge, the manner of operating the test, etc., and in 1915 these specifications were adopted by the American Society of Testing Materials, and they have been widely used by engineers as the standard method of testing paving brick.

Abrasive Charge Comprises Cast Iron Spheres

These specifications made several radical changes from the old rattler, notably in the abrasive charge. The shape of the charge was changed from cubes and prisms to cast iron spheres of two sizes, of which the collective weight was specified as 300 pounds. This charge was to be made up of ten cast iron spheres 3¾ inches in diameter and weighing about 7½ pounds each, and from 245 to 260 small spheres 1⅞ inches in diameter and weighing about 0.95 pounds each. The chemical composition of the cast iron in these spheres was also defined within certain limits.

Paving bricks of the same burn tested with spheres in the new rattler show a differential of about 4 per cent. over the test in the old rattler in which cubes were used. In other words, the new rattler with spheres is more severe (but at the same time more uniform) than the old rattler with cubes. Paving engineers should remember this in designating their permissible limit of loss. Specifications which under the old rattler called for an 18 per cent. brick should now call for a 22 per cent. brick if tested on the new rattler.

Ten Bricks in Charge

The specifications for the brick charge call for ten bricks of the so-called "block-size," and also state that when bricks of larger or smaller sizes than the dimension given for "blocks" are to be tested, the same number of bricks per charge should be used, but allowance for the difference in size should be made in setting the limits for the rattler loss.

The first paving bricks made were of the common brick size, 2½ inches wide, 8½ inches long, and 4 inches in depth. Later these dimensions were increased to the "block size," but no standard block size was adopted—the dimensions falling between 8 and 9 inches in length, 3 and 3¾ inches in width and 3¾ and 4¼ inches in depth. Paving engineers asked for a standard size, but the manufacturers claimed that it was impossible to standardize a paving brick. However, their claim has been disproved, and the manufacturers are now making brick of a standard size, 3½ inches wide excluding lugs, 8½ inches long, and 4 inches in depth, and laying in the pavement 40 bricks to the square yard. The American Society of Municipal Improvements, at their meeting in 1916, eliminated the brick size from their specifications and changed the word "block" to "brick," calling for a standard paving brick 3½ inches in width, 4 inches in depth, and 8½ inches in length, with certain small variations from these dimensions.

Three-Inch Bricks Now Used

Since the use of monolithic and cement-sand bed construction there has been a demand from the engineers for a brick 3 inches in depth, but of the same surface measurement as the standard brick. It is claimed that a brick 3 inches in depth, laid in a cement-sand bed or directly in the green concrete, will give a stronger pavement than a brick 4 inches in depth laid on the plain sand cushion.

Many articles on this subject have appeared in the engineering papers, and there is no question but that a brick 3 inches in depth is both economical and durable, and manufacturers of paving brick are ready to meet the demand for a brick of this depth where such is specified.

Now, the problem is, what allowance or differential shall be given to a brick 3 inches in depth? The specifications for the rattler test distinctly state that some allowance must be given when bricks of other dimension than the standard are tested. Several authorities have given an arbitrary allowance; others have tested 12 and 13 bricks, but as yet no standard allowance has been determined. The practical testing of 3-inch brick gives no authentic data. Some 3-inch bricks have tested as well as the 4-inch brick of the same make, and others have run poorer. There is no doubt that the liability of a 3-inch brick breaking in the rattler is greater than that of the 4-inch brick, and when this happens of course there are more edges under abrasion.

Two Factors Control Result

In the testing of brick in the rattler the two essentials in determining the result of the test are the weight of the brick and the number of lineal inches of edges which are under abrasion, as the loss in the rattler is mainly due to the edges being worn or broken off. This loss varies with the form of the edge or corner of the brick. If a brick has square edges it will lose more in the rattler than one having rounded edges. This variation is especially true during the first 600 revolutions of the rattler. Some paving engineers recognize this variation, and allow a differential of from 1 to 2 per cent. in testing a standard wire-cut lug brick.

A standard 4-inch brick (3½ in. x 8½ in. x 4 in.) has 64 lineal inches of edges, while a standard 3-inch brick (3½ in. x 8½ in. x 3 in.) has 60 lineal inches of edge, or 6¼ per cent. less. Upon an examination of the bats of 3-inch and 4-inch brick after they have been rattled the centre one inch of the 4-inch bat shows very little loss except at the edges. In other words, the bats shows that the 3-inch and 4-inch brick will lose very nearly the same weight of material, the 3-inch brick possibly losing 6¼ per cent. less material, on account of the abrasion on the edges of the middle inch of the 4-inch brick. Therefore, in comparing the two bricks we will not consider the square inches of surface under abrasion, as undoubtedly there is very little variation in loss due to surface abrasion.

Therefore, the two determining factors in the rattler test are the weight of the brick and the number of lineal inches under abrasion.

Permissible Loss in 3-inch Brick

Let us assume that the specifications call for a 22 per cent. loss for a 4-inch brick. Then our factors are: (a) Ten 4-in. bricks weigh 100 pounds and having 640 lineal inches of edges; (b) ten 3-in. bricks weigh 75 pounds and having 600 lineal inches of edges.

By compound proportion, remembering that the heavier the brick the better the test, and the more lineal inches of edges the poorer the test, we have:

$$\begin{matrix} 75 : 100 \\ 640 : 600 \end{matrix} :: 22 : X$$

Solving this proportion, we find X equals 27½ per cent., which would be the theoretical permissible loss of a 3-inch brick under a 22 per cent. specification for a 4-inch brick.

This can be checked by putting in the rattler 100 pounds of 3-inch bricks and eliminating the weight factor, thus: (a) Ten 4-in. bricks weighing 100 pounds and having 640 lineal inches of edges; (b) thirteen and one-third 3-in. bricks weighing 100 pounds and having 800 lineal inches of edges. The proposition would then be:

$$600 : 800 :: 22 : X$$

Solving for X, we find 27½ per cent. the same as in the first proposition.

The City of Baltimore has used a considerable number of 3-inch brick, and below is submitted a report made by Frank A. Duncan, principal assistant engineer to Major R. Keith Compton, chairman of the Paving Commission:

"I beg to submit herewith my investigation as to the allowance that should be made in testing the paving bricks 3 inches in depth . . . :

"In order to determine this, I took a standard —— brick, which is 3½ inches wide, 4 inches deep, and 8½ inches long, getting its cubical contents and its weight, and then selecting a tested —— brick showing a uniform loss, and which I found to be 18 per cent. My idea was to determine the loss of the one-inch in depth which is eliminated when we test a 3-inch brick. This 1-inch strip must be considered as coming out of the centre of the 4-inch brick. This is so because the wearing on the corners and edges are similar in a 4-inch and 3-inch brick. I found that the loss of the 1-inch strip when tested in the 4-inch brick was 7.3 per cent. of its own volume. The total brick is represented as 100 per cent. and the 1-inch strip as 25 per cent. of the total volume of the brick. Therefore, a loss of 7.3 per cent. on 25 per cent. of the brick is equal to a proportionate loss of 1.8 per cent. on 100 per cent., or the brick itself; and the total loss on the brick being 18 per cent., 1.8 per cent. would be 10 per cent. of the total loss. In other words, the 1-inch strip would lose 10 per cent. of the total loss of the whole brick."

This investigation considers the surface abrasion on the middle inch, as well as the abrasion of the edges, and Mr. Duncan states in this instance it was 10 per cent. of the total loss. This is an inviting field for further investigation.

Specify Loss in Pounds

Let us assume that ten 4-inch brick lose 22 pounds in weight when rattled, and if they weigh 100 pounds, this would be a 22 per cent. loss. Now, if the middle inch loses 10 per cent. of the total loss, then, theoretically, ten 3-inch bricks should lose 19.8 pounds in weight when rattled; but as these brick only weigh 75 pounds, this would mean a 26.4 per cent. loss, although in reality they lost less weight of material than did the ten 4-inch brick. It is, therefore, offered for the consideration of engineers that, instead of specifying in "per cent. of loss," they specify the maximum amount of "loss in pounds" which ten bricks shall lose in the rattler. This would eliminate the element of weight. and the rattler test as written in the specifications would apply to all depths of standard brick (3½ inches wide x 8½ inches long), no matter whether the bricks are 5 inches, 4 inches, or 3 inches in depth.

In the testing of brick the large spheres used in the abrasive charge weigh 7½ pounds each, and are heavier than the average weight of the individual 3-inch brick. When the rattler was originally designed the large shots were supposed to imitate the impact due to horses hoofs and the bumping of wagon wheels. Traffic conditions have changed to some degree, and the determination of impact is not as important as formerly. Some engineers believe that the use of large spheres are detrimental in the rattler, as results may be obtained which are accidental; for instance, if a brick becomes bridged in the rattler and is struck in the centre with a large shot, the brick is liable to break, although there may be no structural weakness. Every broken brick adds more edges under abrasion and causes a variation in the test. Would we not obtain a more uniform test if we replaced the volume of large spheres by 75 pounds of the small spheres, thus using the same weight of charges, 300 pounds, for testing, but all small spheres?

What Size of Spheres?

In April, 1916, the Bureau of Tests of the State Highway Department of New York made a series of tests on wire-cut lug brick, using the (1) standard charge, (2) using 300 pounds of small shot only, and (3) using the large shot only. In these tests the bricks were weighed at the end of every 100 revolutions and the percentage of loss calculated and these results plotted as a curve. Upon an examination of these curves the curve representing the percentage of loss due to the charge of small shot is much more uniform than the curves representing the other charges; thus showing that this test is not subject to the accidental breaking of bricks or spalling of corners incident to tests using the large shot.

At the present time the Paving Commission of the city of Baltimore, when they test their 3-inch bricks, are using 10 bricks, replacing the weight of the large spheres by small ones, and bringing the abrasive charge up to 300 pounds, and allowing an additional loss of 1½ per cent. to their standard loss of 22 per cent. for 4-inch brick.

It has been suggested that in testing the 3-inch brick the large spheres be reduced in size so as to be able to obtain a uniform comparison of the tests between 3-inch and 4-inch brick. However, I personally believe that if the large spheres are discarded and only a charge of 300 pounds of small spheres are used, a more uniform test of the brick will be obtained. Here, again, is a fertile field for investigation by testing engineers.

There is no doubt that a differential must be allowed a 3-inch brick over the permissible loss in per cent. specified for a 4-inch brick. How much to allow is the question. Theory shows a certain allowance. Practical tests show a variation. Some advise the elimination of the large shot and a figured allowance. From present data, why not specify the permissible maximum loss in weight of abrased material or compromise on a differential of 4 per cent. over the specified per cent. of loss of a 4-inch brick?

The Quebec Board of Engineers is preparing a monograph on the Quebec Bridge.

Booklet on Pumps

"Pumps for Any Service" is the title of an 84-page catalogue just issued by Darling Brothers, Ltd., engineers and steam specialties, 120 Prince Street, Montreal. It describes in detail, both in illustrations and text, the many and varied lines of pumps and compressors manufactured by this firm. It also contains several pages dealing with important information for the benefit of intending purchasers of pumps.

Mainly Constructional

East and West—From Coast to Coast

City Engineer Parsons, of Peterboro, Ont., has drafted a new building by-law, and a committee has been appointed to give it preliminary consideration.

The new Byron Sanatorium, near London, Ont., for the care of returned soldiers affected with tuberculosis. was recently opened by the Duke of Devonshire.

Last year there were 1,900 summonses issued against motorists for speeding on the Toronto-Hamilton highway, with the result that fines amounting to $6,000 were collected.

The Water Board of the Greater Winnipeg Water District have been authorized by the government to raise the necessary funds for the carrying on of the aqueduct work, through the issue of debentures.

The plant of the Ontario Brick Company at Oakville has recently been sold by the liquidators. The purchaser was Mr. F. W. Palfield, of Montreal, who represents Eastern interests, and the price paid was $250,000.

A concrete roadway, to cost in the neighborhood of $27,000, is planned by farmers living on the Tecumseh Road, Raleigh Township, Ont. It is intended to construct the highway from the limits of Chatham to a distance of 4½ miles below the city.

A resolution passed by the Council of North Vancouver, B.C., and endorsed by the Council of West Vancouver, requests the government to give every assistance to shipbuilding and, because of the consequent demand for steel, to establish a steel plant in the Province of British Columbia.

Reports from Nelson, B.C., state that the Wanetta Power Company's big water-power plant on the Pend l'Orelle River, south of Nelson, is nearing completion. Preliminary construction work has been in progress for some years, though the company has but recently been incorporated, with a capital of $1,500,000. Power will be supplied to industries on both sides of the international border.

The average daily consumption of water in Kitchener, Ont., during the year 1917, according to the annual report of Superintendent Hymen, was 1,169,703 gallons, or 59 gallons per capita. The report showed that 352,221,000 gallons of water were pumped at the Kitchener plant and 73,720,675 gallons were received from Waterloo. The total cost of pumping was $8,193.37, of which $2,901.66 was paid to Waterloo.

The County of Wellington and Guelph Suburban Road Commission has been organized under the provisions of the Ontario Highways Act, its members being Warden George H. Dickson, of the County Council; George Penfold, appointed by the city, and John L. Carter, formerly reeve of Guelph Township and now a resident of Guelph. The commission has designated a total of 31 miles on various roads leading out of the city as suburban roads, to which the city will subscribe 30 per cent. of the necessary expenditures. A resolution was also carried requesting the County of Wellington, at the January session, to make an appropriation of $100 per mile for repair work during 1918.

Kananaskis, situated about 20 miles east of Banff, Alta., in the foothills of the Rockies, will probably be the location of the new Dominion $400,000 tuberculosis sanitarium, according to Premier Stewart. The sanitarium will accommodate 300 patients, soldiers to be given the preference. The estimated cost is $400,000, of which the province has undertaken to pay $200,000. The Dominion authorities are ready to proceed with the erection of the building at once, and expect it to be completed by next fall. It will be built on the unit system.

A deputation from Middlesex County recently waited upon Hon. Finlay Macdiarmid, Minister of Public Works for Ontario, to obtain approval of their plans for a good roads system. The scheme outlined provides for the construction of good roads in various parts of the county to link up the main highways and complete the existing system. It was requested that certain roads be classed as provincial county roads, thus entitling the county to the 60 per cent. government grant. These were the Longwood Road, running through to Chatham, an old toll road, the Sarnia Gravel Road, the Proof Line Road, the Stratford Road, the River Road, and a large section of the Talbot Road. The minister stated that an engineer would be sent to look over the ground with a view to the plans being approved.

In an address before a recent meeting of the Ontario Motor League, Hon. Finlay G. Macdiarmid, Provincial Minister of Public Works, dealt with the importance of the good roads problem. He pointed out that, while millions of dollars had been spent by the government in assisting the railways, the roads in different parts of the province, forming the avenues over which produce must travel for marketing, had been neglected to a certain extent. The good roads system would ultimately result in the reduction of the existing prices for produce, owing to the increased facility of transportation for farmers. The minister said that all but three counties in Ontario had endorsed the government good roads policy, and he expected these counties would fall in line before the end of the year.

The Nova Scotia Steel and Coal Company are extending their operations at Sydney Mines, both in the production of steel and coal. They have just touched on the fringe of two square miles of submarine territory, acquired under lease from the Dominion Coal Company about four years ago. To reach this vast coal area it was necessary to drive a new haulage through old and abandoned workings and retimber the roadway as the work progressed, over a distance of 10,000 feet. Double tracks will also be laid, so that when a loaded train is ascending another train of empty boxes can return to the working face. These big operations will be in full swing when the shipping season opens. Simultaneously work is progressing on the construction of a new steel bankhead for the handling of the product as taken from the mine. At the steel plant a new 250-ton blast furnace has recently been completed. The first step in the installation of a series of waste heat boilers was also undertaken last year. The boiler now working under this process is supplied by the waste gas from one of the open hearth stacks, and it has been demonstrated that there is 400 h.p. available from this source at each furnace. The coal output of the Sydney Mines collieries in the past year was about 585,000 tons, and the steel plant produced 86,300 tons of iron and 128,200 tons of steel. There was also a coke production of 106,150. There are 2,100 men on the colliery department payroll and 1,400 employed at the steel plant.

Personals

Captain William Abbott, Montreal, who has been awarded the Military Cross, was, prior to enlisting, taking a course of civil engineering at McGill University. He was promoted on the field.

Prof. Ernest Brown, M.C.S.C.E., has been appointed by the Board of Government of McGill University a member of the engineering building committee, in place of the late Professor MacLeod.

Mr. H. B. Pickering, of Seattle, has been appointed engineer of construction for the Foundation Company, and will have direct charge of the engineering yards now established in Victoria, B.C., Tacoma, and Portland.

Major H. F. H. Hertzberg, M.C., who has recently been mentioned in despatches by Sir Douglas Haig, is with the Engineers, and is a 1907 graduate of the Faculty of Applied Science and Engineering of Toronto University.

Major Gerald Anglin, M.C., of Montreal, has been awarded a bar to his Military Cross for bravery at the Passchendaele fighting, when he was wounded in the leg. He obtained the Military Cross for conspicuous bravery at the Somme. Prior to enlisting, Major Anglin was connected with the firm of Anglins. Ltd., contractors, Montreal.

Lieut. E. Victor McKague, of Toronto, has been awarded the Military Cross for distinguished conduct at the front. Lieut. McKague, who is a graduate of the Faculty of Applied Science and Engineering of the University of Toronto, was employed with the Toronto Harbor Commission prior to his enlistment. He is 24 years of age, and has been overseas about two years, having left Canada in December, 1915, with the Divisional Cyclists.

Lieut.-Col. C. H. Mitchell, D.S.O., C.M.G., has been decorated with the Belgian Croix de Guerre by King Albert of Belgium. Col. Mitchell, who is a member of the firm of C. H. & P. H. Mitchell, consulting engineers, Toronto, and well known in the Canadian engineering field, is at present acting as general staff officer (Intelligence) with the Second British Army on the Italian front. He went overseas in the first contingent with the Corps of Guides.

Flight-Lieut. E. R. Grange, of Toronto, a 1915 graduate of the Faculty of Applied Science and Engineering, has been promoted to flight-commander, according to reports recently received. He received his commission in the Royal Naval Air Service in September, 1915, and since then has been mentioned several times in Sir Douglas Haig's despatches, and also has been awarded the Croix de Guerre and the D.S.O. He is a son of Principal E. E. A. Grange, of the Ontario Veterinary College.

Obituary

Mr. Alex. G. Cruickshank, of Owen Sound, Ont., who formerly was engaged in the building and contracting business in that city, passed away recently, following a comparatively brief illness as a result of paralytic strokes.

Sir John Wolfe Barry, the well-known engineer, died recently in London, England. Sir John was a member of the Army Railway Council and consulting engineer to many railway and public works corporations. He was also an officer in many engineering and allied societies. He was born in 1836.

Mr. Thomas Cote, one of the controllers of Montreal, who had supervision of public works, died suddenly on January 16. He was a very strong defender of the much-discussed enlargement of the aqueduct with the proposed hydro-electric development, but recently favored the postponement of the project on financial grounds. Mr. Cote was in 1903 secretary of the International Waterways Commission.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Carleton County, Ont.
By-law is being prepared for the construction of roads, costing $20,000, near Huntley Township. Road superintendent, C. F. McClure.

Goderich, Ont.
Town Council contemplate road improvements. Mayor, E. R. Wigle plans to get estimates shortly.

Louiseville, Que.
Town Council contemplate construction of macadam road. Engineers, Roy & Toupin, 72 Notre Dame Street East, Montreal.

Montreal, Que.
City Council contemplate widening Notre Dame E. and St. Denis Street. Engineer, P. Mercier.

North Vancouver, B.C.
City Council contemplate construction of a number of sewers, including 8th and 10th Streets from Lonsdale Ave. to Ridgeway Ave. Engineer, A. R. Clucas.

Norwich, Ont.
Town Council contemplate enlarging pump house and installing additional pump at a cost of $4,000. Engineer, F. J. Ure, C.E., Woodstock.

Town Council intend to do some road work during the summer. Engineer, F. J. Ure, C.E., Woodstock.

Port Colborne, Ont.
Town Council contemplate the erection of a waterworks pump plant and equipment. Clerk, A. G. Ross.

Raleigh Township, Ont.
Township Council contemplate the construction of concrete roadway costing $7,000 on Tecumseh Road. Clerk, A. E. Robinson, Charing Cross.

CONTRACTS AWARDED

Montreal, Que.
Alphonse Gratton, 142 Fifth Avenue, Maisonneuve, has the general contract for sewerage system for the City Council.

West Zorra Township, Ont.
B. Blair Co., Ltd., Riddell St., have the tile, McKay & Armstrong, Embro, the hauling, and Arthur Walters, R. R. No. 2, Embro, the construction contract for 2,700 ft. tile drain for the Township Council.

Winnipeg, Man.
Thos. Kelly & Sons, 504-5 Lindsay Bldg., have the contract for tunnel for the Greater Winnipeg Water District, 501 Tribune Bldg.

Railroads, Bridges and Wharves

Brantford Township, Ont.
Tenders will likely be called about February 15 for the erection of two $2,000 reinforced concrete and beam bridges for the Township Council.

Christie Township, Ont.
Township Council contemplate the erection of a bridge over the Narrows. Clerk, Wells Thompson, Orville.

Fergus, Ont.
Town Council contemplate either rebuilding or erecting new St. David Street bridge. Reeve, J. C. Templin.

Kingston, Ont.
City Council contemplate erection of wharf costing $30,000. Engineer, R. J. McLelland.

Three Rivers, Que.
The Wayagamack Pulp and Paper Company, Ltd., Wayagamack Island, are having plans prepared for $90,000 wharf at St. Maurice River and St. Lawrence River. Superintendent, C. R. Whitehead.

CONTRACTS AWARDED

Lauzon, Que.
Jos. Gosselin, St. George St., Levis, has the general contract for dry dock sheds costing $600,000 for the Davie Shipbuilding & Repairing Co., Ltd.

St. John, N.B.
Kane & Ring, 85½ Prince William St., have the general contract for repairs to wharf for the Department of Public Works, Dominion Government.

Public Buildings, Churches and Schools

Belisle's Mills, Que.
G. R. Richer, Room 908, New Birks Bldg., 10 Cathcart Street, Montreal, has drawn plans for $4,000 two-storey frame presbytery for F. Brosseau.

Cobourg, Ont.
Tenders will be received by the secretary, H. Boggs, until February 14 for the erection of a brick addition to school, etc., for the Public School Board. Plans at office of secretary and architects, Chapman & McGiffin, 95 King E., Toronto.

Forestburg, Alta.
Forestburg, Grainland, Prairie, and Ruff School Districts plan to erect a consolidated school. Address secretary, Forestburg.

Halifax, N.S.
Tenders being received until February 4, addressed to Director of Contracts, Militia Headquarters, Ottawa, for the erection of military huts for the Department of Militia, Dominion Government, Ottawa.

Kanabaskis, Alta.
The Dominion and Provincial Governments of Alberta contemplate the erection of a $400,000 sanitarium.

Kingston, Ont.
The Queen's University contemplate the erection of a $100,000 women's residence. Registrar, G. J. Chown, B.A.

New Glasgow, N.S.
Tenders received until 5 p.m., February 31, for Trane system or any low pressure steam or vacuum system, satisfactory to the School Board, for the old high school. Plans ,etc., for Trane system with the secretary, James Roy.

Ottawa, Ont.
Fireproof doors, auxiliary fire alarm system and chutes will be installed in $25,000 hospital for the Grey Nuns, Water Street.

Redcliff, Alta.
Redcliff Public School Board contemplates the erection of an addition to school. Secretary, W. H. Riddell.

St. Cyprien, Que.
New tenders will be called in March for the erection of a $50,000 church for the parish. Architect, L. Auger, 39 St. Jean St., Quebec.

St. Damase, Que.
Tenders will be called by the Curate, J. E. Lepage, about February 1 for the erection of a stone and steel church for the Parish Congregation.

St. Louis de Courville, Que.
Jos. Gosselin, 55 St. George St., Levis, general contractor for church for the Parish, is receiving tenders for hot water heating for same.

Verdun, Que.
Tenders will likely be called shortly by architect, J. E. A. Benoit, 1200 Wellington Street, for the erection of a $75,000 limestone, steel and pressed brick extension to college for the Roman Catholic School Commission.

J. E. A. Benoit, 1200 Wellington St., architect for $175,000 school for the Roman Catholic School Commission, expects to call tenders about February 1 for the erection of same.

Warner, Alta.
School District contemplate the erection of a consolidated school. Secretary, T. A. Spackman, Wrentham.

CONTRACTS AWARDED

Charlottetown, P.E.I.
K. H. Ferguson has the painting contract for nurses' home in connection with soldiers' convalescent home for the Military Hospitals Commission, 22 Vittoria Street, Ottawa.

Fredericton, N.B.
A. F. Betts, 315 Queen Street, has the plumbing and heating, and Wm. Minto, 321 Queen St., the electrical work for military hospital for the Military Hos-

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The Country Must Conserve Technical Ability to Win the War

THE un-wisdom of allowing our universities to become depleted of technical students can scarcely be better demonstrated than by a circumstance that has happened within the last few days. A large munitions organization required immediately some thirty young men with a fair amount of chemical knowledge, industrial chemistry preferably. Enquiry at one of our largest universities disclosed the startling fact that there is not one single fourth year student in attendance in this department, and only one student in the third year.

This indicates, of course, that many demands have been made on this university for chemical men, and, of course, also, many of those who have gone are doing important work for the Empire because of their special training. The tragedy of the situation, however, is that a considerable percentage of these trained men, now needed so urgently for special work, are serving in the army in capacities where their technical training is of no practical value, and, still more tragic, that no effort has been made to replenish the depleted attendance, from the preparatory schools or elsewhere.

* * *

It is not a mere professional interest that influences us to return again and again to this matter in our editorial pages. We believe it is a question of national importance. In the concrete case noted above, is it not self-evident that the manufacture of explosives is of such primary importance as to demand consideration before any other arm of the war service? And this condition has not been sprung upon us; it has come gradually and naturally and logically and for this reason could have been, and must have been, foreseen by those in authority.

The chemistry department of this university is merely typical. The attendance in the applied science department in the same institution is a mere suggestion of former days. And what is true of one of our universities is doubtless true of all. And yet, with this shortage of technical men so urgently in demand, there are students to-day devoting their time to the study of languages—live and dead—to art, to literature, to philosophy. Of course, no sane man, in this enlightened age, doubts the value of such studies in our national endeavor to develop an "all round" man, but that isn't the type we happen to want at the moment—we want specialists. Not only want them, but must have them or lose the fight. This is no time for a young man to insist on following his natural "bent." His duty is to shape his course according to the nation's need, and the crying need now, and until the war ends, is "technical" men.

* * *

This would seem to point the first step then towards filling the void in our technical departments—direct everything that offers for university training, men and women alike, into the course that will best and soonest fit them for war work.

The second source of supply would seem to be our preparatory schools, where many young men are spending valuable time on war-unessentials and where many others are dropping out for one reason and another just as they are beginning to become useful assets to the nation. Quite a number, no doubt, fail to continue their work further on account of the feeling that military demands will prevent them completing their course. However, the cause is of less importance than the effect. These young men should all be advanced into technical studies as rapidly as possible. If the urgency of the situation is pointed out most of them will willingly shape their course accordingly, but if not, pressure could easily be brought to bear to yield the desired results. And there are other sources of supply.

* * *

We may as well look at the real situation as it exists. Germany, as the most highly developed nation in the world, technically, is, so far, winning the war on the strength of this fact. Britain and her allies are going to thrash Germany "scientifically" or not at all. With these facts staring us in the face doesn't it seem particularly stupid and unbusinesslike that we are taking no steps out of the ordinary to supply the demand?

Bill to Control Practice of Civil Engineering

MR. Adrien Beaudry has introduced into the Quebec Legislature a Bill affecting the status of civil engineers in the province. The Bill, which it may be stated, is not in any way promoted by the Canadian Society of Civil Engineers, provides penalties against any person who, not being the holder of a civil engineer's diploma obtained under the laws of the province of Quebec, practises the profession of civil engineer, usurps the functions of the profession, or does or claims to do any act connected therewith, or assumes verbally or otherwise the title of civil engineer, or makes use of any abbreviation of such title, or of any name, title or designation which might lead to the belief that he is a civil engineer, or a member of the Canadian Society of Civil Engineers or advertises himself as such in any way or by any means, or acts in such manner as to lead to the belief that he is authorized to fulfil the office of, or to act as a civil engineer. Such person shall be liable, on summary conviction, to a fine of not less than $100 nor more than $200, or in default of payment to imprisonment for not more than three months for the first offence, and to a fine of not less than $200 nor more than $500 or imprisonment for not more than six months, for any subsequent offence.

C. S. C. E. Elections and Transfers

THE following have been elected members, associate members, etc., of the Canadian Society of Civil Engineers:—Member—Mr. W. Gore, Toronto, consulting engineer to the Ransome ver-Mehr Machinery Co., of London, Eng., and to the John verMehr Engineering Co., Toronto, engaged in the development, manufacture and installment of drifting sand filters as exemplified in the recent installation for the city of Toronto.

Associate Members—Mr. E. F. Cooke, Victoria, B. C., in 1912-14 resident engineer, Vancouver Island line, C. N. P. Railway; Mr. G. M. Hamilton, 7th Field Co., Canadian Engineers, France, subaltern in charge of engineering works, and previously assistant engineer in charge of party on construction surveys, Welland ship canal; Mr. J. A. Mendl, Saint Boniface, Man., in control of the city of Boniface construction and maintenance; Mr. D. Morris, Victoria, B. C., Imperial Munitions Board, shipbuilding department, Victoria; Mr. T. R. H. Murphy, consulting engineer for Port Arthur Pulp and Paper Company; Mr. V. A. Newhall, divisional hydrometric engineer, Department of Interior, Calgary; Mr. E. D. Todd, Victoria, engineer of streets, city of Victoria, in charge of all engineering work connected with the construction of roadways and sidewalks and of the asphalt plant; Mr. J. B. Wilkinson, Kingston, Ont., Lieut. in 72nd (Queen's) Battery, and previously with Dominion Government as assistant on Geological Survey, Topographical Department.

Transferred from Associate Member to Member—Mr. F. G. Goodspeed, St. John, N.B., district engineer Dominion Public Works, St. John, N.B.; Mr. W. H. Powell, Vancouver, field instructor and lecturer in geodetic surveying and astronomy, University of B. C., and in charge of Dominion Land Surveyor's examinations for province of B. C.; Captain R. H. Winslow, on active service, 2nd Canadian Infantry Brigade, headquarters France, and previously engineer in charge of Vancouver Harbour Commissioners.

Transferred from Student to Junior—Mr. F. P. Flett, Chatham, N.B., in 1914-16 Lieut. No. 1 Tunnelling Co., Canadian Engineers, and now casualty, previously with the Public Works Department, Chatham.

Quebec's Road Building Plans

THE Quebec Government has a moderate road building plan for the present year. According to a correspondent, the Montreal-Quebec highway will be completed this spring, though there remains little to be done, practically the linking up of the road at Batiscan by a bridge, instead of the ferry now used.

The Road Department is preparing to build its St. Lambert-Levis road, and when this is completed, paralleling the Montreal-Quebec road on the north side of the river, the counties south of the river will have three highways, forming a huge arc, the ends touching points in the United States. There is a proposition for another road on the south shore running from St. Lambert, through Sherbrooke and into the States.

On the south shore also surveys have been made for a road from Levis down to Fraserville, in Temiscouata County, and there is the project for a highway from Beauce Junction to Robertsonville for the purpose of connecting Quebec with Thetford Mines and Sherbrooke by the Levis-Jackman road. Another road, that from Beauceville to Sherbrooke, through Lambton, has been completely surveyed, and work will probably start at an early date. The Minister has also a plan for a road from Montreal to Ste. Agathe, running through Mont Laurier, which will serve as an aid in colonization.

Supply of Drain Tile is Not Sufficient

AT the first annual meeting of the Ontario Farm Drainage Association, held recently at the Ontario Agricultural College, Guelph, the president, Mr. S. W. Hyatt, stated that the supply of drainage tile is very much below the demand and that the labor question was quite important. Much poor work, he claimed, was being done by ditching machine operators throughout the country, and he suggested that if an arrangement could be made whereby a certificate of efficiency might be given to operators after having passed the proper examinations, it would be a great help to the drainage work. To make certain of obtaining sufficient supply of tile for the work to be done during the year, it was suggested that the farmers, machine operators and owners, who comprise the membership of the association, would do well to co-operate with the tile manufacturers.

The fuel famine, according to the first vice-president, Mr. M. Murray, was making it difficult for the tile manufacturers, particularly the clay tile manufacturers, to make tile satisfactorily. If many of the tile makers had considerable capital, they would be able to make tile cheaper because they could make it in larger quantities. Mr. Murray claimed that in some districts concrete tile was selling somewhat cheaper than the clay tile and as far as he knew was giving satisfactory results.

The Quebec Government proposes to introduce a bill in the present session to form a bureau of municipal affairs for the province.

Cantilever Arch Design Adopted for the Keith Bridge at Newmarket, Ont.

An Artistic and Economical Structure of Reinforced Concrete Built by the Toronto and York Highway Commission

By E. M. Proctor, B. A. Sc.

WHEN the Toronto & York Highway Commission took over the Sutton Road, running east through Newmarket, Ont., it was found necessary to renew the bridge at the Holland River in Newmarket. This bridge was a light steel span with wooden floors, and was neither wide enough nor heavy enough for the increased traffic. The steel span was erected in 1889, and when taken down was in a very fair state of preservation. The bridge was sold for $150 in place, and was later used to span the Don River on a private estate, being used as a roadway over a concrete dam, as shown in Fig. 7.

The Toronto & York Highway Commission in 1917 decided to renew this bridge, and instructed their engineer, Mr. E. A. James, B.A.Sc., M. Can. C. E., to design a reinforced concrete structure, having economy of materials particularly in mind. Since the Toronto & York Highway Commission have always endeavored to secure bridge structures that present a pleasing appearance, the problem before the engineer was to design an economic bridge that was artistic in design.

Cantilevered Arch Design Preferable

After a careful study of different types of bridges, it was decided to use a cantilevered reinforced concrete design, as shown in Figs. 1 and 2. Several considerations led to the adoption of this type, that is, soil conditions prohibited an arch structure; the required waterway did not demand a clear opening greater than 30 feet, which is the centre span; a deck type bridge was more desirable than one with trusses or guides projecting above the floors; the high water level was about 4 feet below bridge floor, which called for a shallow floor, and lastly, but not least, this type was cheap and possessed pleasing lines.

The bridge is designed as shown in Figs. 3, 4 and 5. The centre span is composed of two cantilevered arms projecting from the centre piers, while the two shore spans and abutments act as anchors for the cantilevered spans. The reinforcement in the cantilevered area is composed of 1 in. diameter rods at 4 in. centres, placed 2 in. from the top of the slab. In the bottom of the slab ½ in. diameter rods at 24 in. centres are placed. In order to prevent possible unsightly cracking, a free joint is left in the concrete across the centre of the centre span, and to keep this joint from developing a bump caused by possible deflection due to loading, every third rod is made continuous across the joint. A checkered plate covers the joint on top of the slab.

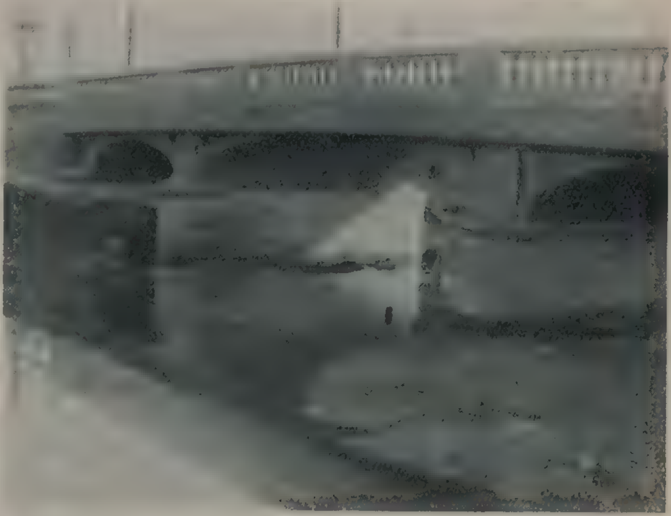


Fig. 1—The cantilever arch design employed in the Keith bridge at New market is pleasing in appearance and economical of materials.

The anchor span is reinforced as shown by ¾ in. rods at 4 in. centres in the bottom, and the 1 in. rods from the cantilever span extended across the top. Every third rod is stopped as shown. The centre span is 13½ in. thick at the centre, and the anchor span is 19 in. thick at the centre.

Details of Piers and Abutments

The centre piers are 4 ft. wide at the top and 5 ft. wide at the bottom. They are reinforced as shown

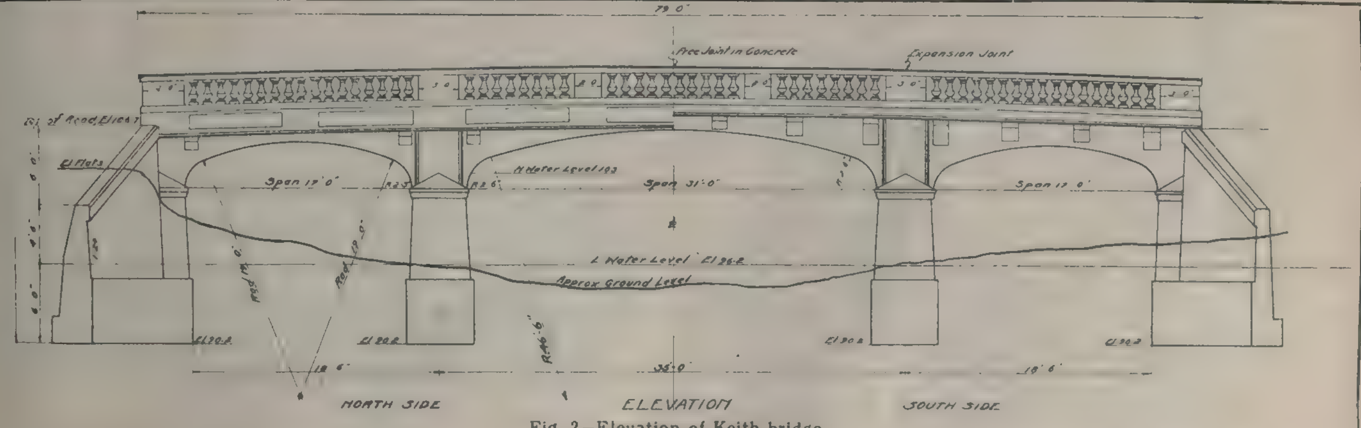


Fig. 2—Elevation of Keith bridge

Secretary-Treasurer of James, Loudon & Hertzberg, Ltd., Consulting Engineers, Toronto.

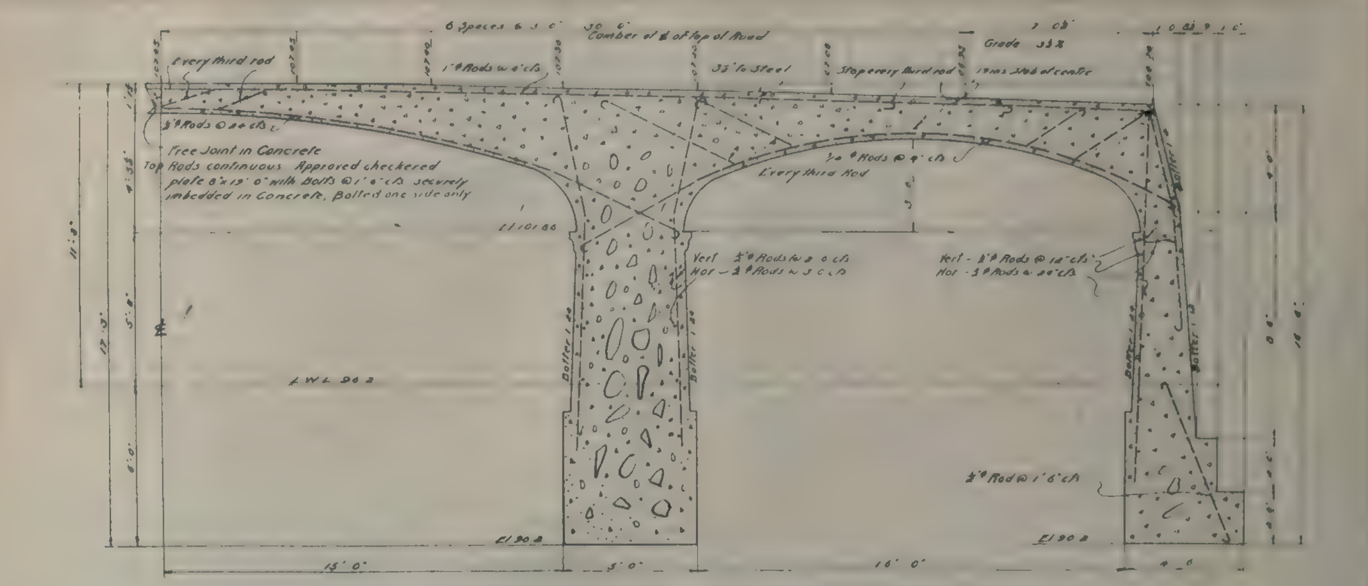

Every third rod
Free Joint in Concrete
Top Rods continuous Approved checkered plate 8"x 19' 0" with Bolts @ 1' 6" c/s securely imbedded in Concrete, Bolted one side only
Every third Rod
L.W.L.
Batter

Fig. 3—Half longitudinal section on centre line of bridge, showing reinforcing steel.

with ½ in. rods. The contractor was allowed to place "one man" stones in this pier up to the springing line. The piers bear on a hard blue clay, and are carried 6 ft. below low water level.

The abutments are figured as vertical beams restrained at the top and having a lateral bearing at the base. They are 18 in. thick at the springing line, and 2 ft. 6 in. at the top of the footing. The footing is 4 ft. 6 in. wide. At the back for a distance of 4 ft. down is placed a batter of 1:4 to counteract the frost thrust against the bridge. These walls are reinforced with ½ in. rods at 12 in. centres at their outside face, ½ in. rods at 12 in. centres extending about half way down the back face, and ½ in. rods at 18 in. centres reinforcing the heel; ½ in. rods at 24 in. centres reinforce the face horizontally. This abutment bears on the same material as the centre pier, and is carried down 6 ft. below the low water level. Fig. 5 shows the plan view of the pier and abutment. The wing walls were designed as light gravity sections with a small amount of reinforcing steel.

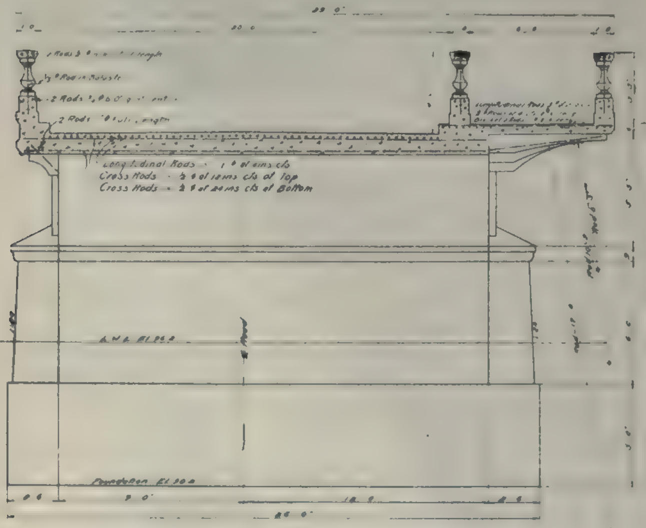


Fig. 4—Cross section on centre line of middle span.

Fig. 4 shows a cross section of the bridge floor taken at the centre of the centre span. The roadway is 20 ft. in the clear ,and the sidewalk 6 ft., making a total width of 29 ft. The railings are a balustrade type, as shown in Fig. 6, and were made 4 ft. in height to conform to the specifications of the Department of Highways, Ontario.

Sidewalk is Cantilevered

The sidewalk is figured as a cantilever slab, and is reinforced with ½ in. rods at 4 in. centres. The brackets are used for appearance and as stiffeners, each bracket being reinforced with two 1 in. rods.

The balustrades were cast in cast iron molds constructed in quarter sections. Half section molds were tried, but were found unsatisfactory because of the difficulty of getting the unhardened spindles out without injury. The balustrades, posts and bases were cast in place after the floor had been cast. The balustrade railing between the road and the sidewalk was used because of the proximity of the sidewalk to the road, which causes very disagreeable splashing of mud on pedestrians during muddy weather.

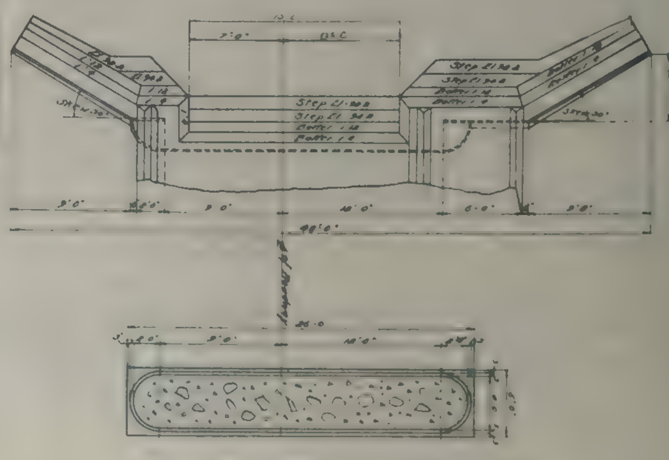


Fig. 5—Plan of abutment and section of pier.

Drainage is taken care of by a vertical curve of 9 in. rise and a crown of 2 in. in the centre of the road.

Concrete of 1:2:4 mix was used for the part above springing line, and 1:2:5 in the substructure, and

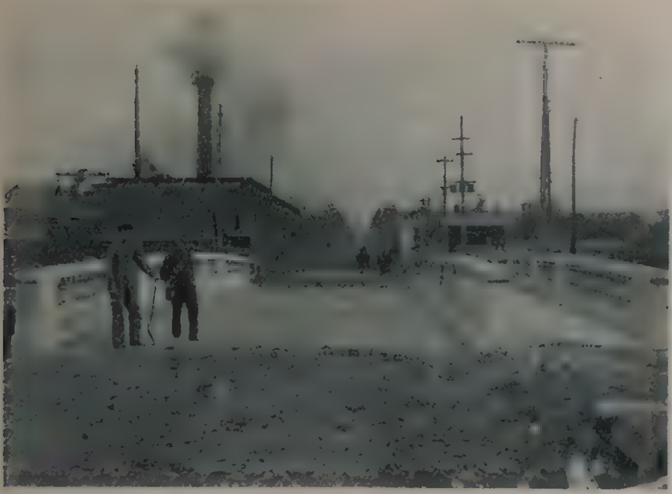


Fig. 6—Bridge has sidewalk on one side with fence between road and sidewalk.

1:2:3 in the railings. Gravel with crushed stone added to secure proper mixture was used throughout.

Quantities

The quantities in this bridge are as follows:—

Substructure	cu. yds.	218
Superstructure	cu. yds.	170.5
Railing and brackets	cu. yds.	27.7
Total	cu. yds.	416.2
Reinforcing steel	lbs.	24,400

Unit prices for extras or deductions:—

Concrete	per cu. yd.	$8.00
Excavation	per cu. yd.	1.50
Reinforcing steel	per lb. in place.	.05

The contract price for this bridge was $5,464 for the concrete work, and $1,098 for steel work, making a total of $6,562.

This is the second bridge of this type to be erected in Canada. The first was the Mount Pleasant Road Bridge, which was designed by the city of Toronto, while the writer was with them as bridge engineer, and which was described in the Contract Record of December 12th, 1917. The Toronto & York Highway Commission are building another similar bridge at Locust Hill, Ontario.

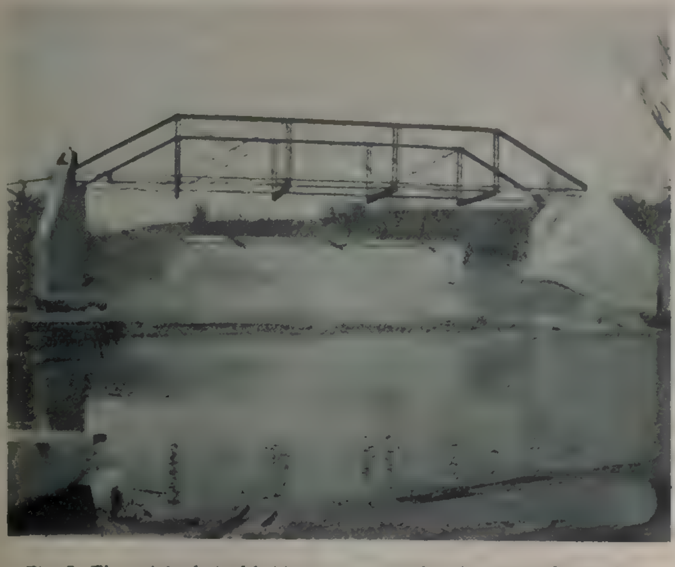


Fig. 7—The original steel bridge was removed and re-erected over dam, as shown.

On account of the economy of materials and the aesthetic qualities of this type of bridge, it should be suitable for many localities throughout the country.

Pulp and Paper Plant and Industrial Townsite at Ocean Falls, B. C.

On Couzen's Inlet, about 230 miles north of Vancouver, the Pacific Mills, Ltd., representing a syndicate of wealthy San Francisco and Portland capitalists, has created one of the greatest industrial enterprises in Canada, and one that will vie with the best of its type on the American continent when the plans of the men in control are fully realized. An army of men has been employed on construction work for almost two years, but much remains to be done to both plant and townsite before the plans in hand are pronounced complete.

The first paper making unit of the big plant began operations June 1st, one newsprint and one kraft paper machine giving an output of about ninety tons per day. A second unit is now completed and will contain two of the largest type of papermaking machines; one of these is already in place and will be started up early in the new year, while the second has arrived from the eastern factory and the parts are now being assembled preparatory to erection. With the two units working to capacity the output will be in the neighborhood of 230 tons of paper every twenty-four hours.

A modern sawmill of mammoth dimensions breaks down the pulp logs for the digestors after all the clear lumber has been taken off. At the present time considerable spruce aeroplane stock is produced, and plans are being perfected which will result in the output being very greatly increased. The starting of the second and larger unit means that the log output must be trebled at least, and with the coming of spring, woods operations will be systematized and conducted on a very large scale. Orders for the necessary equipment—all of the most modern kind—were placed several months ago and some of it has already been delivered. The company owns very extensive pulp limits and will operate a standard gauge railway and four or five powerful tugs.

The town of Ocean Falls enjoys a picturesque location and the company is leaving nothing undone that will add to the comfort and happiness of the population, which is principally made up of the workmen and their families. Now there are about 2,000 citizens, but when everything is in full swing next spring the town will contain over 5,000 people.

On account of the congestion of the railway service and the expressed wish of the United States Government to restrict passenger traffic to the minimum of necessity at this time, the Board of Directors of the American Concrete Institute on January 16, 1918, decided to postpone the annual meeting of the institute until June 24-26, 1918, at Atlantic City, N.J. Full preparation had been made for the regular meeting at Chicago on February 7, 8, and 9, 1918, but the directors feel that patriotism impels the postponement until the later date. Copies of the program, amended to meet this condition, together with preprints of papers and reports, will be mailed to the members at least two months in advance of the convention. It is hoped that these papers and reports will be made the occasion of written discussion, to be submitted at the meeting in June.

What Montreal Builders' Exchange Has Done

President, in Reviewing Past Year's Work, Believes Building Minimum Has Been Reached — Exchange is Concerned in Reforms

IN spite of the dullness in building activity, the Montreal Builders' Exchange had a successful year. The attendance at the annual meeting on January 28 was unusually large. Mr. J. P. Anglin presided. The financial statement, submitted by Mr. D. K. Trotter, the secretary-treasurer, showed a balance on the right side, the statement being characterized by Mr. T. Gilday, a past president, as the best during five years.

Mr. Anglin, in reviewing the work of the past year, briefly dealt with the war situation, in part as follows:

"Now coming to the war time operations of the members of our Builders' Exchange. I must first thank the members for their loyal support during 1917 and especially the directors, who have been most faithful in their attendance at meetings, and by their help have made the Exchange a success.

"Our real business for 1917 reached about a minimum, at least we hope so. As in previous years, our members' chief building operations were outside of Montreal. Speaking generally, I believe that Montreal contractors have obtained their fair share of Canada's building work. I think it would be very interesting if figures could be compiled showing the total year's turnover of all of our contractor members for the past six years. You will, no doubt, be anxious to hear the real figures of the slump in building operations in the Dominion, and also in Montreal during this term.

"The published government records for building permits in thirty-five cities are as follows:—

Year	Canada	Montreal, Maisonneuve, Westmount	Per Cent.
1912	$185,000,000	$24,000,000	13
1913	156,000,000	32,000,000	20
1914	97,000,000	21,000,000	22
1915	34,000,000	9,000,000	26
1916	40,000,000	6,000,000	15
1917	35,000,000	6,000,000	17

"These figures probably represent 9/10 of the buildings done by contractors, but, of course, do not cover dams, piers, bridges and roads constructed by building contractors.

Believes Minimum Has Been Reached

"I wish I could predict with even reasonable certainty what 1918 has in store for us all, but I will leave you to draw your own conclusions by simply stating that I believe we have reached the minimum. There are as many enquiries for buildings as usual at this early season, but unless costs reduce, much of the building will be held over. Structural steel is already easier in both supply and price, and other materials will follow, but we cannot look for much reduction in this line. We should constantly remind prospective clients that no real reduction is likely for some time.

"I am convinced that we builders and supply firms should study the tendency to standardize building construction. It is made necessary in order to reduce the cost, because by adopting proper designs, much material could be saved and, therefore, time as well.

"The one abnormal event of 1917, which staggered Canada and which will probably increase our building operations, is the awful destruction of buildings and lives due to the explosion at Halifax. Your directors have had frequent meetings to discuss this matter; and a committee was appointed consisting of the president, and Messrs. Irving and Dykes to follow up events and see what opportunity there was for our Montreal members in future Halifax buildings.

What Exchange Has Done During Past Year

"For the information of those members not in close touch with our Exchange work, I will recite a few of the many matters considered or dealt with during 1917.

"We sent a memorial to the Government at Ottawa jointly with the Architects' Association and the Canadian Society of Civil Engineers, protesting against the employment of contractors, architects, and engineers from across the line on important government works, and thereby influencing large private corporations to do the same. We believe this had the desired effect.

"Your directors were mainly instrumental in removing the Montreal Tramways question from civic politics, and took every opportunity to urge the legalizing of freight carrying by the tramways so long as passenger traffic was not delayed thereby. The Commission is about to report, and we hope that their findings will be fair to the citizens and the Tramway Company alike.

"An important move in the right direction was the formation of the General Contractors' Section of the Exchange, to deal with all matters pertaining to masonry, concrete and brick contractors. This movement needs to be extended to all trades.

"We have continued to agitate from time to time for direct representation on the Provincial Technical School Board and hope, by keeping at it, to gain this privilege. We believe a closer relation between ourselves, apprentices and the Technical School would benefit both the boys and the school, and if this were realized we would be assured of a supply of efficient mechanics for the future.

Interested in Better Government for Montreal

"When called upon, we studied the schemes for the better government of our city, and in due course brought forth a sound program, the adoption of which, we believe, would be in the best interests of Montreal. The result is yet unknown, but we can depend upon Sir Lomer, our Premier, doing the right thing by the city.

"What general gatherings we have held during the past have been well attended and the members have shown a keen interest in their Exchange. The fraternal feeling is growing between our members and every opportunity should be taken to promote this acquaintanceship, as in so doing we will strengthen both our business and our Exchange."

After thanking the members for their support and also thanking Mr. Trotter, Mr. Anglin concluded:

"I want to mention the names of General Loomis and Major Cape, who gave up so much in order to serve their country. I am sure you will join me in the hope that they will both return to their families in safety and good health before another year has passed. We should also remember the many brothers, sons and employees of our members who have gone to save the Empire in France. Many have been wounded and some have made the great sacrifice. Let us never forget to be grateful for what they have done. It should spur us on to greater personal effort and make us ever more proud of our calling and our country."

Offer Assistance in Revising By-laws

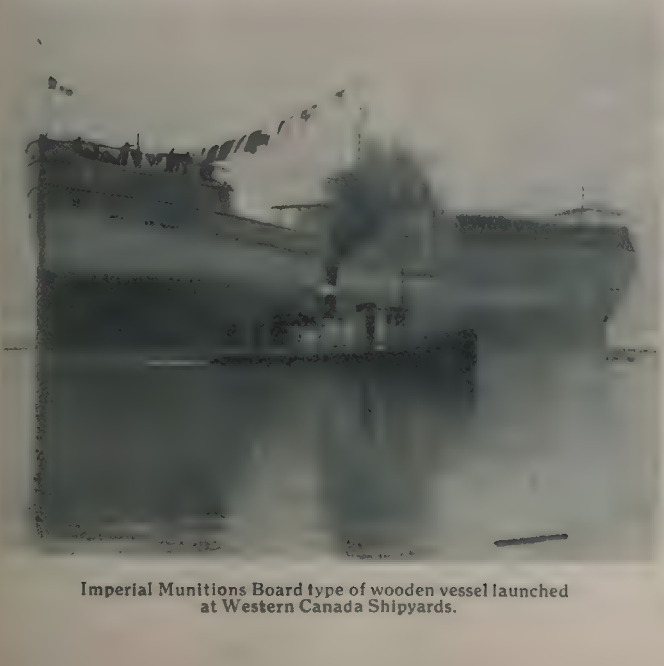
On the motion of Mr. J. Hand, seconded by Mr. J. Allen, it was decided that steps be taken to obtain copies of the building by-laws of the municipalities in the Montreal district, and to suggest to the municipalities who propose to revise their by-laws that the Exchange be consulted, so that the experience of the members might be utilized in drawing up new codes.

The election of officers resulted as follows: President, Mr. J. P. Anglin (re-elected); first vice-president, Mr. R. F. Dykes, T. A. Morrison & Co.; second vice-president, Mr. W. M. Irving, general contractor; past president, Mr. John Quinlan, general contractor; directors, Messrs. A. Charette, master plumber; H. Fussing, general contractor; Fred B. Locker, president of Montreal Mantel and Tile Dealers' Association; W. E. Ramsay, builders' supplies; J. J. Roberts, carpentry and mill work; A. Rutherford, lumber; Walter Ryan, master plumber; Charles F. Smallpiece, hardware; H. Vincent, electrical contractor; J. E. Walsh, sanitary and heating engineer; A. H. Webster, builders' supplies.

Pacific Coast Shipbuilding

Types of Wooden and Steel Vessels Being Constructed in British Columbia—Will Mean Much After the War

THE wooden steamer, War Nootka, one of 46 similar standard type vessels contracted for in Canada by the Imperial Munitions Board, has been launched by the Western Canada Shipyards, False Creek, Vancouver. The design is from the shipbuilding department of the Munitions Board offices at Ottawa, and it attracting the attention of shipping men, as it is believed that this type of vessel will mean much to the shipbuilding industry of British Columbia after the war. Vancouver shipping men have declared that there will be a big market for many years for wooden vessels of the type now being constructed by the Coast shipyards. British Columbia is in an excellent position for their production, as Douglas fir is the wood specified and the timber for which this province is noted. The dimensions of the vessels are as follows:—Length between perpendiculars, 250 ft.; length over all, 259 ft.; breadth, extreme, 43½ ft.; breadth, molded, 42½ ft.; depth, molded, 25 ft.; depth, over keel, 27 ft.; draft for displacement, 22 ft.; draft over keel, 21 ft.; deadweight on 20 ft. maximum, to Lloyd's summer freeboard, approximately 2,500 tons; deadweight on 20 ft. draft, approximately 2,800 tons.



Imperial Munitions Board type of wooden vessel launched at Western Canada Shipyards.

Type of vessel built in British Columbia for river service in India.

Only the completed hulls are furnished by the contractors, all other iron work and fittings being supplied by the Munitions Board.

Victoria Firm Building Steel Vessels for India

The steel sternwheeler "Sarak" is the first vessel of its kind built by Yarrows, Limited, at Esquimalt, B. C., and which is now operating on the rivers in India. This vessel is 132 ft. long, 31 ft. beam, with a loaded draft of 3 ft. 3 in., draft light 18 in., the speed of the vessel being ten miles per hour. The trial trips of the "Sarak," which were run in India, have proved the vessel to be a very great success. Yarrows, Limited, have built and shipped two more of these vessels to India, and have another one under construction; they are also starting to lay down another sternwheeler 165 ft. x 35 ft. beam, also for service in India.

The parent firm, Yarrow & Company, of Glasgow, have built twenty-eight light draft vessels, which are in use in Mesopotamia as gunboats, also one repair ship and one hospital ship. Their service to the army has been of very great value, particularly for the swift transport of staff, troops and supplies.

Civic improvement leagues have recently been formed in a number of cities and villages in Manitoba and British Columbia.

Clay Products Manufacturers Meet in Annual Convention

Speeding Up Tile Production and the Use of Low Grade Fuels Were Among the Matters of Interest — Drain Tile Situation

THE sixteenth annual convention of the Canadian Clay Products Association opened at the Prince George Hotel, Toronto, on Tuesday, January 29. Disruption of the railway traffic delayed many of the members, but over fifty delegates were registered for the opening session. The proceedings were started by an address of welcome given by Mr. Thomas Kennedy, of Swansea. Owing to the absence of the president from the opening, and the delayed arrival of some of the delegates slight changes in the programme were made necessary.

The election of officers at the opening session resulted as follows: Past-president, A. F. Greaves-Walker, Baltimore; president, Thomas Kennedy, Swansea; vice-presidents, William Burgess, Todmorden, Ryland H. New, Hamilton, and G. Angus German, Toronto; secretary-treasurer, Gordon C. Keith, Toronto.

Councillors: Charles B. Lewis, Toronto; John S. McCannell, Milton; Walter Clark, Corunna; T. H. Graham, Inglewood; Charles A. Millar, Toronto; Andrew Dods, Mimico; J. E. Frid, Hamilton; N. T. Gagnon, Montreal.

Entertainment committee: C. A. Millar, chairman; technical education committee, Millard F. Gibson, chairman.

To Test Labrador Clays

The convention in considering a proposal from Dr. Wilfred Grenfell, medical missionary in Labrador, relative to the desirability of manufacturing brick for home building in that country, decided to render all possible assistance in testing the clays of Labrador with a view to the determination of their possible utilization in brick making.

The establishment of a national school of ceramics was also foreshadowed, and it was suggested that a school with a well-equipped laboratory, kiln and machinery, should be established in connection with the Central Technical School, Toronto.

The geological aspects of the clay industries were sketched in a paper by Professor N. B. Davis, of Kingston, on "The Relation of the Economic Geologist to the Clay Industry." Following its presentation, a special committee was named to ascertain the possibilities for the development of the tile products industry. Following a talk by Mr. W. G. Worcester, secretary of the Alberta Clay Products Manufacturers' Association, on "Kiln Konstruction Kinks," a discussion ensued with respect to brick making throughout the Dominion. It was suggested that many of the smaller brick plants might advantageously be equipped and operated for the manufacture of tile. This proposal in relation to the general stimulation of Canadian brick making, will be considered by a special committee.

Drain Tile Situation

At the Wednesday session, Mr. W. H. Scott, drainage demonstrator of the Ontario Agricultural College, Guelph, dealt with "The Drain Tile Situation in Ontario," laying stress on the fact that in western and southern Ontario tile was used to a much greater extent than in any other part of the province. The central and northern counties of Ontario are not using tile to the extent that it should be. Mr. Scott has been assured that the demand for tile this year will be much greater than the supply, the lack, according to the manufacturers, being due to the shortage of labor. In some districts manufacturers had booked orders sufficient to keep their plants operating at full capacity for the next six months. Standardization, according to Mr. Scott, was one matter in which the Clay Products Association can materially help the industry. An agreement upon standard sizes for tile will mean a saving of a large amount of time, waste, labor and money, and at the same time will enable manufacturers to supply consumers with a better article. The duty of tile manufacturers is closely coupled, according to Mr. Scott, with the movement for greater productivity. He stated, "the land owners and the farmers look to the manufacturers for their supply of tile and if they are unable to produce all the tile required, the work of drainage and reclamation of land will suffer, and just so much as that suffers there will be less grain and other agricultural products at present when greater production is so necessary."

Workmen's Compensation

Mr. Samuel Price, chairman of the Workmen's Compensation Board of Ontario, delivered a paper on, "The Workings of the Workmen's Compensation Act and How Assessments are Determined for the Different Classes." Following its presentation, a special committee was appointed to confer with the board with a view to determining whether it would be possible to work out a system of merit rating. The committee will also obtain information as to the amount contributed by the employers who come under the brick and tlie section of the Act and their percentage of payments toward the maintenance of this particular branch. It was felt by some of the employers that the rating was too high and that they had to pay much more money correspondingly than under the insurance liabilities system.

The other papers read at the session were: "Sewer Pipe Manufacture," by F. Coleman, Hamilton (which is reprinted in this issue); "Difficulties in the Manufacture of Clay Products," by L. L. Plant, Georgetown; "Refractory Materials in Canada," by Joseph Keele, B.Sc., chief engineer, Ceramic Dept., Mines Branch, Ottawa; "The Application of Electric Motors in the Claymaking Industry," by Kenneth C. Berney, Canadian Westinghouse Co., Hamilton; "Producer Gas-fired Dryers," by R. H. McElroy, International Clay Machinery Co., Dayton, Ohio.

A paper on the manufacture of floor and wall tile, by James McCabe, ceramic engineer of the Frontenac Floor and Tile Co., Kingston, had to be postponed owing to the impossibility of the author reaching Toronto in time for the convention.

Annual Banquet

On Wednesday evening a banquet was given at the Prince George Hotel. Among the speakers were Mr. Greaves-Walker, 1917 president of the Clay Products Association, Mayor Church, Toronto, Lieut. F. B. McFarran, recently returned from the front, Mr. W. G. Worcester, secretary of the Alberta Clay Products Manufacturers' Association, Mr. Frank McCannell, Rev. A. Logan Geggie, and Miss Margaret Davidson. Miss Davidson, who is connected with the Central Technical School, Toronto, spoke in regard to "Women's Influence in National Development." Mr. Greaves-Walker, formerly of Toronto, and now Maryland manager of the American Refractories Co., Baltimore, spoke of the cordiality existing between the United States and Canada at this time.

To Use Low Grade Fuels

At the Thursday session, proposals directed toward a solution of the fuel problem were put forward in a paper by W. G. Worcester, of Calgary, entitled, "Burning by the Use of Forced Draft and Low Grade Fuel." The author suggested that slight constructional changes involving alterations to grates and the use of fans and forced drafts, could be made in existing kilns, which would permit of the efficient use of low grade fuels for kiln purposes, thus releasing the better grades for other industrial and domestic uses. Mr. Worcester explained how the lignites of the West could be made available. In the discussion which followed, it was agreed that tile manufacturers could practise a more efficient use of fuels by substituting the lower grades and altering their furnace designs and methods in order to make this possible. The poorer grades of bituminous and the lignites approaching peat were quite available. It was not possible, however, to use peat. A suggestion that crude oil be used as fuel was, after discussion, considered impracticable at the present cost of oil.

Speeding Up Tile Production

At the closing session, the best methods of speeding up the production of tile in Ontario with a view to interesting the farmers as to the advantages of tile drainage were discussed. A special committee was appointed to wait on the provincial Department of Agriculture and seek the government's assistance. As the officials of the Department of Agriculture are in close touch with the farmers of the province, it was felt that the department might co-operate with the clay manufacturers in the matter of speeding up production and guaranteeing the sale of tile in counties where it has not been used. The government will be asked to equalize transportation costs, to assist in the distribution and carry on an educational campaign to ensure a demand in the agricultural sections for drainage tile. If these arrangements are satisfactorily concluded, the clay products manufacturers will make an effort to operate and equip with tile machinery many of the brick plants at present idle in different parts of the province. These have been closed down on account of the curtailment of building operations and if there is sufficient call for tile these might well be reopened. In that way, with the co-operation of the government, it is believed that the industry can be developed and thus obtain a large amount of the tile business in Canada now controlled by American tile manufacturers.

The discussion disclosed the fact that many of the smaller tile manufacturers in towns and villages were selling tile at prices that did not include the overhead charges, with the result that the prices were so low that the larger manufacturers made no effort to compete. Smaller concerns could not turn out the amount of tile required by farmers while the larger manufacturers hesitated to accept business at a loss.

The convention closed without a decision as to the place of meeting for the next convention. Montreal is regarded as the possible location, but the matter was left to the executive council to decide.

Manufacture of Sewer Pipe

By F. Coleman, M. B.*

IN offering this Association some remarks on the manufacture of sewer pipe, it is necessary to keep in mind the fact that but a few of its members are directly interested in this branch of clay working. An attempt will therefore be made to state some facts that may be of interest to all in some degree, and be sufficiently worthy of the consideration of those engaged in this business to elicit their helpful criticism.

Raw Material

In considering this question the presence of alumina and silica, the basic and essential constituents of clay substance, is assumed, and attention is turned to the other contents, which are more or less incidental but of much importance, and to the necessary qualification of a suitable material.

We in Ontario make use of a deposit, usually called medina shale. The harder and more brittle shale, which is found rather abundantly, and from which such excellent dry pressed brick is made, and the surface clays used for the manufacture of common brick, are not suited for the purpose. In a general way the suitable material may be said to occupy an intermediate position. It is more plastic than the harder shales and differs in respect to chemical composition, while at the same time possesses a stronger body and different burning qualities than the lighter surface clays.

Any material to be suitable must possess sufficient plasticity to permit of its being pressed and moulded into forms. It must be of such a nature that it will pass through the dryer without excessive warping or cracking, and finally, it must burn until a vitrified body and salt glazed surface is produced.

Experienced observers may search for and find what appears to be the required material. A thorough test is then to be made throughout the entire process, and this may verify or negative the opinion formed. A favorable result of such a test is not, however, sufficient evidence upon which to make the investment required for a plant. It may turn out that the sample (even if large, which it should be) was only a pocket.

Chemical analysis is still less dependable; such a test may indeed prove that a sample is not suitable, but by itself it can never be relied upon as a proof that it is suitable.

Lime a Source of Trouble

Among various other contents of the clay, lime may be particularly mentioned, as it proves very troublesome in this part of Ontario. It is met at every turn and at every stage of the process, and always spells "trouble." Its presence is at times fairly evident and hence more easily avoided, but at other times your first intimation is spoiled ware.

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* Of Hamilton and Toronto Sewer Pipe Co., Ltd.

Lime occurs chiefly in one of two forms: (1) Larger or smaller pieces of carbonate of lime—these may be colored red like the shale and may be quite soft, or hard and stony; (2) Carbonate of lime in a very finely divided state mixed throughout the material; and solution of salts of lime. This division is made on account of the different defects produced rather than because of chemical differences in the two classes.

The lumps may enter small enough or be ground fine enough to permit passage through the screen plates of the dry pans and not be specially or at all noticeable in the ware when pressed or while drying. When the goods are burned these pieces of carbonate of lime are converted into the oxide or quicklime. Upon removal from the kilns and exposure to rain or even to the moisture of the atmosphere, the pieces of lime become slacked. The pressure resulting from this change is sufficiently great to burst the surrounding material, and holes are produced of varying size in which is seen the lime.

Prevents Glazing Action on Tile

In the second form in which lime occurs, the trouble assumes a different character. Under these circumstances the lime is carried by the water through the pores of the ware to the surface; here evaporation takes place and the water leaves the lime behind as a whiteish more or less crystaline scum on the surface. This scum is added to as more water brings more lime to the surface during water-smoking until a more or less heavy coating results.

The sulphur fumes from the coal gas acts upon this lime, producing the sulphate of lime or gypsum. This does not burn off and prevents the action of the gases on the ware. The soda of the salt used for glazing is similarly prevented from acting on the clay substance. The net result of this surface condition is grayish colored goods instead of the browns or black required, and the entire absence of glaze.

Another effect of lime to be mentioned now and referred to later is due to the fact that it is a powerful flux. The presence of any considerable quantity results in vitrification occurring earlier and more suddenly.

To overcome these effects of lime, chemicals may be used (chiefly barium carbonate) and are in some places where the percentage of lime is not too high. However, when the labor and other costs of overcoming the defects of raw material become multiplied, it becomes a question whether it would not be better to secure material from a less polluted source.

Effect of Carbon and Iron

The presence of carbon in material otherwise suitable, is perhaps, in this locality not of serious importance. It occurs chiefly in the form of larger or smaller roots, and some other vegetable substances. Much of this is to be screened out; the balance, of course, has to be burned out. The carbon present may be a cause of black coring, but this color is not simply charring—it is chiefly due to the fact that the iron present has been reduced by the carbon to the black oxide.

Of course, it is known that red shale contains iron. This important constituent is not only responsible for the color of the goods, but is also a powerful flux, safe and salutory under proper conditions, but disastrous if improperly managed.

The iron occurs chiefly in the form of ferric oxide, although some carbonate may be present, and, at times, sulphite. The latter two, however, sooner or later, lose the carbonic acid gas and sulphur respectively, and are changed into oxide. In the presence of sufficient oxygen, or under oxidizing conditions, the red ferric oxide results, under reducing conditions, in black or ferrous oxide. That there is an important difference between these two becomes apparent during burning.

Gathering and Preparing Material

The gathering of raw material offers little worthy of comment. The usual stripping to get rid of surface loam and vegetable materials is familiar to all, as is also the fact that a particularly strong clay may be the better for admixture with some of the lighter surface soils. Where such mixing is desirable, it is well to take together the full depth of the bank used.

At times it becomes necessary to shift or even to abandon a considerable area when the implacable lime menace is encountered. At other times a substantial bank peters out to an unprofitable shallowness.

It is fairly apparent why plants for the manufacture of sewer pipe in Ontario are centrally located and not erected upon the ground from which it is expected to secure raw materials. Insufficient quantities in a given location to last a number of years necessitates rather frequent shifting. It then becomes necessary to load material to railroad cars and to unload from same at the plant, and it then matters but little whether the haul is one mile or forty.

The preparation differs very little from that required for other clay products. The material should be ground in the dry state, usually by dry pans with screen bottoms. Further and finer screening is very desirable when possible. The material is then conveyed to hoppers, from which it is delivered by chutes to the wet pans for wet grinding or tempering. For the smaller sizes little further mixing is required, but for the larger, grog must be added to open the pores of the thicker body, that drying may be more rapid and more complete. For moulded ware more tempering and more careful selection of the material to be mixed is required.

Making the Ware

The machinery employed has not changed in essential features for many years. There is the steam press and the plaster moulds of our forefathers. Whether this fact indicated a want of inventiveness in this industry or an unusual wisdom on the part of the pioneers, must be left for others to judge.

The dies used require careful consideration, and must be adapted to the needs of the individual manufacturer and his material. Many of you are aware how great a difference a very slight change of variation in a die may make. Changes in raw material must also be met by necessary die changes. A die that will make a perfectly satisfactory pipe with some clays will not be at all suitable for others.

Drying

Drying is a very important step in the process. Just here it may not be amiss to suggest that in considering the requirements and difficulties of any part of the process of manufacture, it is necessary that all previous steps be appreciated and their influence appraised. One may say that certain defects resulted in drying. This may be true, but not be the fault of the drying process. Quite possibly that should be traced back to the raw material, or its treatment at any stage before reaching the dryer. This holds true for conditions until the pipe are entirely finished.

The floor space required for drying is rather considerable for as a rule each pipe has to stand alone. Means must be provided not only to supply the required heat and to distribute it evenly, but also to carry off the moisture-laden air.

We employ a steam heated concrete ground floor with spaced wooden upper floors, and a chamber of steam-heated pipe coils from which the warm air is distributed to all parts by means of a motor-driven fan and a system of galvanized conduits. In addition there has been recently installed overhead steam-heated pipe coils to increase the efficiency. Numerous and large ventilators in the roof provide the means for carrying off the moist air.

The temperature that the ware will stand has to be rather closely gauged at times and this may be checked by the use of recording thermometers.

Large pipe cannot be exposed, with safety, to temperatures that may cause no harm to smaller sizes. Too great a current of air, whether warm or cold, direct upon the pipe, must always be avoided.

To dry the ware as quickly as possible favors increased output and economy, but too much haste results in large wastage and defeats the object of low cost.

The pipe should remain in the dryer until bone dry, which takes from three to fourteen days, according to the size of the pipe and other conditions, such as the weather, etc. If set in the kilns in an underdry state, some of the troubles resulting should be charged to this fact and not to the burner.

Kiln Practice

The kilns are of the usual round down draft variety in which the pipe are set in circles. Those set nearest the bags are so arranged that they escape too direct action of the fires. The usual custom is to set several sizes in each kiln with the larger ones towards the centre, where they are placed in tiers four high. Nesting cannot be adopted to advantage, to any considerable extent, as the lessened draft between such pipe is likely to spoil both, but particularly the inside ones. In sizes of 16 inches and upwards small pipe may be set. Small pipe are also bunged in the spaces between the large ones. Traps, elbows, and other fittings are placed on top of pipe of suitable size from which they are separated by dry rings to avoid pressure effects.

The kiln floor should be as level as possible and under each bottom pipe is placed a ring of corresponding size. This helps to overcome any inequalities of the floor and permits the pipe when shrinking to creep more readily.

Burning

Burning involves four processes: (a) water-smoking, (b) dehydration and oxidation, (c) vitrification, (d) glazing.

It is our custom to commence firing immediately with coal, only sufficient wood for kindling purposes being used. The coal must be screened lump, long-flamed gas coal of good quality, and particularly, it must have a low sulphur content.

The early or water-smoking period is accomplished by firing lightly that the increase of heat may be slow and gradual.

Although appearing and feeling dry when set there is much water in the ware to be disposed of. This water is not chemically combined, but is so closely joined to the clay substance that considerable heat is required for its removal, and it is probably not all removed until the coolest part of the kiln reaches a temperature above 400 degs. F. It is chiefly at this time that blistering and slabbing occurs, and this is usually found in the larger-sized pipe with thicker bodies.

This water must find its way from the deeper parts of the ware through the pores to the surface from which it escapes. Much of it must first be converted into steam and if steam is produced too rapidly or in too large a volume at any one time, the pores cannot contain it and internal pressure results, with separation of the laminae of the ware and swelling. Carried a little further this pressure will cause the outer layers to separate and the slabbing mentioned results. The degree of this defect varies from blisters of different sizes to a condition in which but little of the pipe remains standing.

To determine when water-smoking is completed, the cold rod test is frequently relied upon, but this will not show whether the danger of the period has been avoided.

Pyrometer Makes Good Guide

It is of little value to know that the water is gone if in the going the ware has been spoiled. What is needed is a means of knowing that the process is being safely conducted, and for this purpose the writer is of the opinion that the pyrometer is the best guide. By this method the temperature may be known and regulated both as to the top and the bottom of the kiln, and having ascertained a safe rate of advance, the results will be constant for fairly constant starting conditions.

The heat may now be advanced more rapidly, as but little change occurs in the ware until the stages of dehydration and oxidation are reached. This is a period during which water is again liberated from the ware, but now it is the water of crystallization or that which was chemically combined with the clay substances.

At or about the same temperature required for this result, other changes in the chemical arrangement of the clay substances also occur. The carbonate gives off carbon dioxide, the sulphides liberate sulphur and the carbon is burned out.

Having reached the important period of oxidation, care must be taken to prevent the fires from being of too reducing a character. Of course, as fuel is supplied and then gradually burns we have alternating, reducing and oxidizing conditions. Up to a certain point or temperature, such alternation does no harm, but as the stage of vitrification is approached, oxidizing conditions must be maintained.

While the ware is still porous enough to permit of free interchange of gases, the black coring of ferrous oxide may be changed almost at will, but when the ware begins to assume a close, dense character, the black that is present remains for keeps. The kiln may still be finished and saved, but at great risk, and with an inferior product. The risk lies in the fact that vitrification occurs earlier and more suddenly in the presence of the black oxide than in the presence of the red oxide. As stated, the presence of lime also tends to early and rapid vitrification.

Vitrification

As a result of increased temperatures, further changes take place with the production of a more or less glassy condition of the ware. Dehydration and subsequent oxidation cause disintegration of various ingredients of the clay substances with opening up of the body of the ware. At that time the porosity is increased and the absorption high. Vitrification causes a fusion or union. The spaces are gradually filled and the ware shrinks. The substance becomes dense and darker in color, the strength is greatly increased, and the absorption of water reduced.

Such ware will absorb but little water and will not permit its passage. It is unaffected by corroding gases, acids or alkalis, and is for these reasons a safe and sure carrier for sewage, whether sanitary or industrial.

Salt Glazing

These qualities of the ware are enhanced by the final process of salt glazing. With the kiln ready for finishing and the fires all hot, a shovel full of salt is well scattered over each. The salt is split into chlorine gas, which passes off, and free sodium which combines with the surface forming the silicate of soda glass.

The heat is maintained by adding to each fire a bundle of wood and a small amount of coal. This is repeated from three to six times, according to results obtained, as shown by trial pieces. The process may have to be shortened if the appearance of the kiln indicates that the heat cannot be safely continued.

The burning may now be said to be completed, but unless the kiln is properly managed, much damage may yet result. Everyone with experience has seen trial pieces that when taken out during the burning showed a mirror-like glaze and yet when the pipe were removed from the kiln the beauty was gone. The glaze was still there, but not the gloss. This change occurred during the cooling, and is the result of the action of the gases in the kiln and of those coming from the fire boxes.

Remove Gases from Kiln

The remedy for this is to rapidly remove the gases from the kiln and to prevent the gas from the cooling fires from entering. The former may be accomplished by freely opening the kiln, completely closing the stack opening and thus producing a strong back draft. This is perfectly safe if not too long continued. To avoid gases from the fires, the latter may be drawn.

Opinion vary as to the best methods of cooling kilns. The object, of course, is that this may be accomplished as quickly as possible and yet that air checking of the ware may be avoided. It has been advocated that the kiln openings be closed and the hot air gradually withdrawn through the flues and stack. Others claim that such a method favors air checking and recommend that the kiln be cooled without the aid of the stack draft. Our experience would suggest the latter method as being the safer one. As in other stages, time-saving must not unduly risk pipe loss, and air checked goods are of no value.

We employ as aids in the control of burning, pyrometric system, trial pieces of ware, pyrometric cones, and in addition to these such skill as the burner may possess from observation and experience.

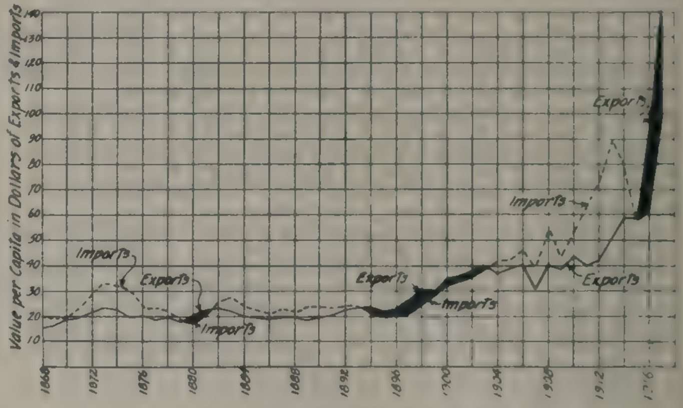
A discussion of methods and merits of the pyrometer would be out of place at this time, but we believe it to be very helpful, particularly in the early stages of burning.

The trial pieces are a necessity. They are placed on top and bottom pipes in various parts of the kiln, within reach of hooks. From these, the condition of the ware from time to time may best be judged, and especially the important stage of oxidation.

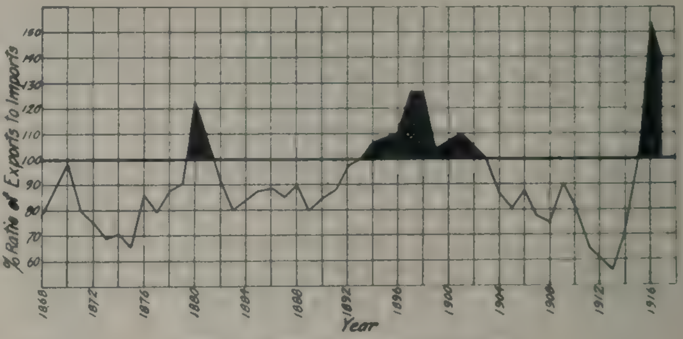
Pyrometric cones furnish valuable information as to the period of finishing. These, like the ware, are affected both by the degree and the amount of heat and fluxing conditions.

How Canada's Trade Varies

TWO interesting curves are reproduced below. They illustrate the trend of Canadian exports and imports from 1868 to the present time and show the relation between these. It will be seen from Curve No. 1 that for all except three periods aggregating fifteen years the imports entered for consumption have exceeded our exports. For the three periods referred to, exports show a surplus above the imports—an ideal commercial situation. These periods of prosperity are indicated by the solid black areas enclosed by the curves where the export curve is above the import curve. Curve No. 2, which shows the ratio of exports to imports, indicates our trade conditions in a slightly different manner. In this case the black areas where the curve exceeds the 100 per cent. mark represent the periods when exports have exceeded imports. A remarkable feature that may be deduced from the graphs is that between the periods of extremely prosperous trade conditions, there is the same number of years in each case—eighteen years, the points of maximum excess of exports over imports being 1880, 1898, and 1916.



Curve 1.—Trend of exports and imports.



Curve 2.—Ratio of exports to imports.

There has just been published under the title, "Urban and Rural Development of Canada," a report of a conference on urban and rural development, held in Winnipeg in May, 1917, under the auspices of the Civic Improvement League of Canada and the Commission of Conservation.

Methods of Repairing Bituminous Pavements

Paper Read Before Association for Advancement of Science Outlines Relative Efficiency of Various Remedial Measures

By George H. Biles*

IN recent years there has been marked development in the methods of repairing and rehabilitating bituminous pavements. There are innumerable instances where pavements had apparently arrived at a stage of such failure that their entire reconstruction seemed justifiable, but by scientific, efficient and economic methods of the highway engineer they have been repaired, at a great saving in cost, which in the end is one of the most essential factors in all construction work.

Bituminous Macadam Pavements

Bituminous macadam is represented principally by the penetration method type of pavement. Naturally, in the analysis of this subject, the first thought is directed to the causes of the various forms of disintegration or failure in pavements of this type and, whereas it is extremely difficult in all cases to arrive at definite conclusions, observation, experiment and laboratory analyses of samples taken from the pavement furnish invaluable data from which fair judgment can be made.

The bituminous penetration method road in its various stages of disrepair or disintegration furnishes a fertile field of opportunity for study and experiment. The most common deficiency in this type of work is found in the non-uniformity of the surface.

Defects of This Type

As an example, we have first, a section of road where the surface is composed of spots of excess bituminous material and bare or lean areas where the binder is lacking in quantity, which condition results in a short time in a ravelling or breaking up of the road surface. This condition is usually caused by improper distribution or by incorporating the bituminous material when the stone is not thoroughly dry.

Second: A rough surface is presented where the stone is loosened or ravelled, the binder showing rapid deterioration, generally causing a series of pot holes. This may be occasioned by improper or overheated bituminous material, unsatisfactory aggregate or faulty sub-drainage.

Third: At times we have apparently a lifeless surface, insofar as the bitumen is concerned, but upon further examination it is found to contain bituminous binder with considerable life a slight depth below the surface. This condition is due in many cases to an insufficiency of bituminous material.

Fourth: A pavement may present a wavy and uneven appearance, and this is usually due to an excess of bituminous material or is caused by the bituminous material being too soft to withstand the action of traffic.

Fifth: There are surfaces which consist of ridges of material which are the result of irregular or improper pouring—in most cases, careless hand pouring. A surface of this kind suffers quickly from the impact of traffic and the attack of the elements and early disintegration is the result.

Sixth: We have a fairly well shaped, uniform surface becoming porous. This condition is true of all bituminous highways in time, as it represents the beginning of the deterioration of the bituminous material.

Effective Repair Methods

It will be seen that before repairs are taken up on bituminous macadam roads, careful study and examination are necessary in order to select the most effective method. Taking the several conditions in order as hereinbefore mentioned, the first case, if taken in time, can be repaired by sealing the dry or lean spots in the surface with a light, heated application of bituminous cement of the binder grade, or the cold bituminous surface treatment materials in quantities ranging from one-tenth of a gallon to three-tenths of a gallon to the square yard of surface, covered with chips or pea gravel, using between fifteen and twenty pounds to the square yard. Unless the surface is worn badly, repairs of this character will even up the surface to a true cross-section, giving added life to the pavement.

The second condition calls for heroic treatment if of any great extent, and a complete scarifying and harrowing of the surface becomes necessary. All disintegrated material must be removed and sufficient new stone added to give the required depth before the surface can be repenetrated and sealed as in the original construction. If, however, the affected portions are only occasional and do not represent the greater area, they may be cut out, cleaned thoroughly and filled with new stone, making due allowance for compression, then penetrated, etc. If drainage conditions are responsible for the failure, they must be corrected before any surface repairs are taken up.

Renovating Lifeless Surface

The condition described in the third example may be treated in two ways. The most economical so far as first cost is concerned would be to give the pavement a treatment, in sufficient quantity to fill the surface voids, with a material that will penetrate and enliven the old material, followed by a covering of good, hard stone chips, using about twenty pounds to the square yard. The alternative would be to scarify and harrow the whole surface, supplying additional new stone in quantities as the rolling would indicate to be required to give the proper cross-section, and penetrating the surface with a bituminous binder, sealing again as in the original construction. In the latter method, the surface must first be thoroughly cleaned and in scarifying and harrowing, the remaining bituminous material in the road must be distributed as evenly as possible. If the material found in the pavement, however, does not possess life, this method is a hazard.

Rectifying a Wavy Surface

In the wavy, corrugated surface, where there is found to be an excess of bituminous material, it is generally more economical and satisfactory to scarify and reshape the surface, adding new stone in order to take up the excess bitumen, and again sealing the surface. This same method should be followed where waves have been caused by the bituminous material being too soft, only, perhaps, more stone would be required in the reconstruction and it would be essential to incorporate a harder bituminous binder than was used in the original construction.

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* Second Deputy State Highway Commissioner of Pennsylvania.

Occasional waves in the surface may be taken out in the due course of ordinary repairs by cutting off the high places and resealing, if the conditions are very pronounced, or by cutting out the depressions and replacing with new material.

A surface full of ridges due to improper pouring, if not too pronounced, may be evened up by painting between the ridges with bituminous cement and covering with stone chips or gravel. This method may be continued from time to time until the surface is entirely evened up. This condition may also be corrected by scarifying the surface with the object of obtaining a more uniform distribution of the old bituminous material and, after rolling to the proper shape, by applying a surface treatment of a cold bituminous material that will enliven the existing material and seal the surface. This treatment is covered with stone chips in the manner prescribed for regular bituminous surface treatment work.

Reviving Bituminous Material

In the last case, we have a properly constructed bituminous penetration pavement but the bituminous material is starting to deteriorate. This can be enlivened or revived by cleaning the surface and applying a seal coat of material in quantities, depending upon the degree of disintegration. Caution should be exercised to avoid applying an excess amount, which results in a slippery condition and is very objectionable to horse-drawn traffic. Generally one-tenth to one-sixth of a gallon is used and brushed into the surface with hand brooms. The surface is then covered with chips or gravel approximating twenty pounds to the square yard. In the use of certain slow drying cold bituminous materials it will be observed that the new material softens up the old bitumen somewhat, giving the appearance at first of an excess application, and, having a hard surface underneath the road becomes quite slippery, but this condition obtains for only a short period of time.

To insure the best results, one-half of the road should be treated at a time in order that the traffic may use the other portion while the bituminous material is setting up. This method has become quite effective and results in increased life to the pavement.

Heated Binders Preferable

In the repairs of breaks, depressions and local defects, which may occur under any one of the general conditions previously outlined, it is more satisfactory to use hot bituminous binders, and if replacements are necessary, they can be made after the fashion of the original construction. This work can be done very efficiently in this manner with little equipment and the average class of labor. There are a number of instances where cold bituminous compounds can and are being used successfully in certain seasons of the year on pavements of this kind, but in cold weather there is usually difficulty with some of this material, owing to its composition. As an example, the emulsified products break down or separate and their adhesiveness is destroyed at low temperatures. Materials that are cut back with natural solvents can be used later and give very good results. The mixtures can be prepared at some point, not exposed to the weather, but convenient to the work, hauled to the site of the repairs, and deposited. This is an effective method in case of emergency.

Bituminous Concrete Pavements

The various mixed bituminous pavements, with the exception of sheet asphalt, are included in the class of bituminous concretes.

Careful observation in locations where there is considerable bituminous paving shows that different streets, in spite of the fact that they have been constructed of the same material, present different appearances. Cracking of the surface is one of the greatest, as well as one of the earliest defects that may develop in bituminous pavements. This may be due to one cause or a combination of several causes. Frequent cases are noted in bituminous wearing surfaces which, although apparently satisfactory mixtures in all other respects, contract as the base contracts and crack open at exactly the same point as the foundation. Again, cases are noticed of otherwise satisfactory pavements which crack because of their failure to receive the amount of traffic necessary to give the pavement its full compression or to iron out and close up the surface after low temperatures have tended to open it up by stretching the bituminous binder. A condition of the sort last described, however, may have been hastened considerably or even caused directly by what might be called improper design of the pavement in the first place.

Toughness and Hardness of Mixture Depends on Traffic

The bituminous surface mixtures expected to receive heavy traffic should be tough and fairly hard in order to resist displacement. Those designed for light traffic should be softer and more yielding, and this is accomplished by using a softer bitumen, that is, one of a higher penetration. Failure to do so means that as the pieces of mineral aggregate contract or shrink in volume during cold weather, they exert a spreading force in the surrounding bitumen, which it cannot withstand because of its lack of light fluxing oils and corresponding ductility or ability to stretch; in other words, pavements containing hard or non-ductile bituminous material will have a greater tendency to crack in cold weather. Similar results and even general disintegration of the wearing surface may have been produced by too little bitumen in the mixture, since this is largely a measure of the life and elasticity of the pavement, and similarly overheated mixtures suffer a hardening and reduction of bonding power of the bitumen, with consequent tendency to crack and wear. Aside from faulty drainage, poorly proportioned mixtures and unsuitable ingredients contribute largely to the failures in this type of pavement.

Slight Surface Disintegration

A bituminous concrete pavement which is satisfactory in all other respects may show surface indications of slight disintegration. The material in all probability has been attacked by the elements and evidence of wear is shown as the gloss is gone and the discoloration of the surface, which approaches a light, brownish hue, is noticeable. This is speedily followed by a general porous condition and, if not promptly attended to, will allow the surface to retain moisture, which will eventually break the bond of the material and result in ravelling and failure of the pavement.

The wavy condition of the surface found in the bituminous macadam roads is also common to the bituminous concrete types. This condition is usually found on well travelled streets, especially on grades, and is caused mostly by the bituminous mixture being too soft, which gives it a tendency to push under traffic. A wavy surface may be attributable to the methods used in the construction of the pavement, for, if in the building the material was not at a temperature suitable for raking to a uniformly loose condition, or crept under the roller as a result of careless handling or being rolled while too hot, an irregular surface would result. Pushing or waving in local spots may often be traced to the laying of the mixture on a dusty or dirty surface.

Wearing Along Edges

The wearing and deterioration along the edges of bituminous pavements where there is no header, is responsible for one of the most troublesome and expensive forms of repairs to roads of this type. The traffic continually irons out the surface along the edges and this spreading or flattening out produces a feather edge along the sides. The moisture and foreign material tracked on from the shoulders soon attack the bituminous material and result in the crumbling or breaking away of the surface which occasions extensive repairs. This condition is more pronounced when the material in the shoulders is of a non-porous nature or is poorly drained.

In the repairs to the bituminous concrete pavements, special care is required in determining the methods and materials to be used. Taking the several conditions enumerated in the foregoing in their order, we first have a cracked bituminous surface, and, unless the cracks are caused by some serious form of disintegration in the pavement, they can be repaired by cleaning them out thoroughly and pouring them full of either a hot or cold bituminous material of the proper grade, and thereafter tamping or wedging stone chips into the crack, thoroughly sealing it. If the crack is wide enough and the edges have crumbled or broken off, they should be cut down evenly and the opening filled and tamped with a mixture of one part bituminous cement to nine parts chips, in sufficient quantity to insure complete closure.

Replacement of Surface

When the entire surface is cracked or broken and is uniformly bad and gradually crumbling away due to the disintegration of the material from any of the several causes hereinbefore mentioned, it becomes necessary to remove the old material and replace with a new surface. If the condition exists only in local spots this will develop into pot holes or depressions which can be repaired by cutting out the affected areas down to the foundation and replacing with a new mixture.

The character of the bituminous material to use depends entirely upon the conditions in each case. Unless the repair work is extensive, it is not deemed advisable to use hot bituminous compounds in this work, not only from an economic standpoint, but from a point of convenience as well. Small repairs in the proper season can be handled economically and efficiently with cold bituminous cement, and if the proper mixture is used in the regular working season excellent results can be obtained.

Cold Weather Repairs

It is conceded that hot bituminous repairs are not generally satisfactory when made at low temperatures, but in some places the avoidance of this practice has been carried almost to a fault. As an example, in some of the larger municipalities where defects have developed in the surface during the winter months, the affected portions have been removed and repaired with brick or stone block. This method is not only objectionable on account of the annoyance to traffic, but, when the regular season for repairs arrives, it is usually found that additional work is required, occasioned through the inequality of the surface. It has been stated by some of the advocates of this method that it is an assurance that the affected portions will not be overlooked when the repair work is taken up in the spring. It has been demonstrated, however, that where conditions are so acute that this method is warranted, there is justification for making special arrangements for preparing and placing a suitable bituminous mixture which will be more satisfactory in the interim and, whereas, probably not a complete success, will offer as good, if not better, opportunities to correct later than the first method, which seems only to be justified when repairing cuts made in the pavements by public service corporations in the winter season.

Light Application Will Revive Surface

When the surface of a bituminous concrete pavement begins to show that the bituminous material is disintegrating and the surface has a dry, porous appearance, similar to the appearance of the bituminous macadam pavement previously described, the surface can be revived by a light bituminous surface application the same as in the former case.

The wavy, irregular surface on bituminous concrete pavements is one of the most unsatisfactory conditions pertaining to the bituminous type of pavement. It is a defect that in most cases is proof positive of the inability of the pavement to meet the traffic requirements, except when the fault may have resulted from the methods used in the construction rather than the materials. If the materials have been found unsatisfactory and the irregularity of the surface is increasing steadily, reconstruction will eventually be necessary.

If the surface is only affected in local spots due to any of the other causes enumerated, this area may be removed and replaced with a new mixture which has been properly selected and strict attention should be given to the requirements of the mixture in order that a repetition of the original deficiencies cannot obtain.

When the proper material has been used in the original construction and the surface is irregular through careless methods in spreading, beneficial results can be obtained from rolling the surface in hot weather with a tandem power roller operated by a competent man.

Preventing Edge Wear

In the repairs to the edges of a bituminous pavement not confined by headers the first and most essential thing to do is to correct the cause, if possible. If the drainage of the shoulders or base is faulty, this should be taken into consideration first and ample provision made therefor. On shoulders which are composed of non-porous material, it is advisable to cut scuppers or small surface ditches at intervals of approximately twenty feet along the road, and, in addition to this, the material immediately along the edge of the pavement should be replaced for a depth of a few inches with broken stone or gravel tamped into place to produce a more stable buttress for the new bituminous material. The patches should be made by removing the affected area and replacing with new mixture. Successful repairs should neither be above nor below the surrounding surface when finally compacted.

In municipalities where there is enough yardage to warrant a central mixing plant, this is the most satisfactory method of handling bituminous repairs. With every facility at hand to compound the mixture properly, more uniformity is assured and much of the personal equation resulting from separate organizations is eliminated. There are localities where possibly small portable mixing plants would meet the requirements and give satisfactory results. However, under ordinary conditions, the problem is generally a small town with probably several short streets or some other unit, such as a county or state, with continuous stretches of miles of interurban bituminous pavements or highways. In either case, it means one or a number of outfits performing the repair work, which conditions give strength to the demand for simple and efficient methods. With trained men, good hot bituminous mixtures have been prepared by hand, but considering the chances taken in over-heating the material, the careless proportioning and mixing and the extra expense in connection with the handling of the equipment, etc., it does not justify this method. The cold bituminous mixture with the proper material is the most economical and fool-proof method for ordinary repairs. The material can be mixed on a regular mixing board, stock prepared for future use, if need be, and stored at convenient intervals along the road, and, aside from the small tools, such as shovels, rakes and tampers, no other equipment is absolutely necessary. Repairs have been made with cold bituminous mixtures on extremely heavy travelled roads that are in excellent condition after four seasons of wear.

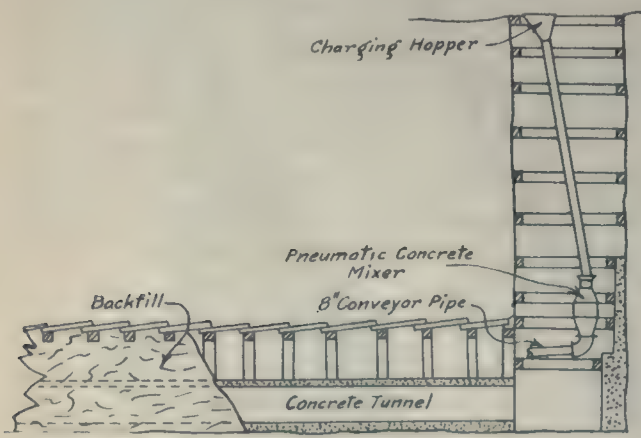
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Large Tunnel Backfilled by Compressed Air by Means of Pneumatic Mixer

A RECENT novel use to which a pneumatic mixer and conveyor was put, was the backfilling with earth of the space on the outside of a reinforced concrete tunnel constructed for the Montreal Tramways Company. This tunnel was constructed by the Laurin & Leitch Engineering & Construction Co., Ltd., of Montreal, between the Hochelaga power house of the Montreal Tramways Co., and the St. Lawrence River, a distance of 150 feet.

The semi-circular section of the reinforced concrete tunnel was formed both inside and outside, and this necessarily left a large space on the outside around and over the tunnel which was required to be backfilled and puddled.



Pneumatic mixer deposits backfill without need of tamping.

The pneumatic mixer was set up in the shaft at one end of the tunnel, with the discharge pipe running in over the completed concrete. The mixer was charged from the roadway above by gravity, with earth and the proper amount of water. When the proper charge had been put into the mixer, the air valves were turned on by the operator and the material was mixed and conveyed to the point of deposit, where it was discharged with great force. Lengths of conveyor pipe were removed from the line as the space filled up. This proved to be a most effective way of backfilling where ordinary methods would have been very expensive. The material, after being deposited by this process was well packed and firm, and required no other tamping.

The accompanying sketch gives an idea of this method of backfilling.

Sliding Forms Used for Walls and Roof of Tunnel After Floor is Placed First

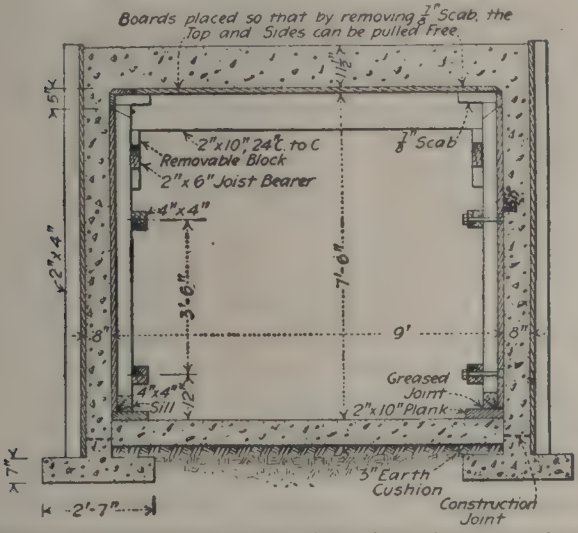
SLIDING forms were found to effect a great saving in time and labor in the recent construction of a concrete tunnel for the Eastman Kodak Company. The tunnel, connecting the power house and a new building, is 810 feet long, and will be used to carry steam pipes and electric conduits.

The specifications called for a footing 31 inches wide under each wall, a 7-inch floor slab and a 3-inch earth cushion between the floor slab and the top of the footings. In order to get a firm base on which to slide the forms, and also to avoid mud and water, it was desirable to pour the floor slabs before the side walls. The footings and 5 inches of the walls were therefore concreted first. The 3-inch cushion was then placed and the floor slab poured. The sliding forms, shown in the drawing, and described in Engineering News-Record, were then set in place, the walls and roof slab being poured together.

The inside forms were built in three 16-foot sections and were set on a 2 x 10-inch dressed plank runner well greased on top. On this plank the side panels bore directly. They were made up above ground, and consisted of a dressed 4 x 4-inch sill, 2 x 4-inch battens on 2-foot centers, and ⅞-inch sheathing.

The roof slab was supported on 2 x 10-inch joists on 2-foot centers, which rested on continuous 2 x 6-inch joist-bearers nailed to the side forms. Between each joist and the 2 x 6-inch bearer a 4-inch block was placed which could easily be knocked out, permitting the roof panels to drop 4 inches. The joist and roof panels were made 8 inches shorter than the width of the tunnel, which permitted the side forms to be drawn in 4 inches on each side, and gave clearance enough for the forms to be slid along to their next position. The top corners were filled in with loose boards held in place by ⅞-inch scabs, as shown on the drawing. These boards remained sticking to the concrete when the sides and roof were collapsed.

The wall forms could be pulled in by means of two 4 x 4-inch rangers bolted to each side. It was planned to use carpenter's bench clamps to draw in the sides, but these were not strong enough. A rope loop slipped around the 4 x 4's and twisted with a bar was very effective. The collapsed forms were moved forward by six men with a double tackle. Three 16-foot sections, making 48 lineal feet of tunnel, were placed and concreted at a time. The three sections could be collapsed, moved forward and re-erected within two days by six carpenters.



Footings and floor placed first, partly collapsed forms slid on greased joints.

The exterior wall forms were built and placed with panels 20 inches wide, tacked to 2 x 4-inch battens 2 feet apart, and wired every 20 inches. The tunnel was designed by the Eastman Kodak Company and built by the Ferro-Concrete Construction Company. The forms were designed and built by Stacey Campbell, superintendent of the work, O. E. Brown, carpenter foreman and the writer, form designer for the contractors.

The Barrett Company have issued a circular descriptive of the Barrett Specification roofs on the plant of the National Aniline & Chemical Company, Inc., which is the biggest concern in the American dye industry. The plant in question is the Schoellkopf Works at Buffalo, N.Y., comprising buildings having more than twenty acres of floor space. The roofing is of five-ply, Barrett specification, pitch and felt waterproofing with slag wearing surface, guaranteed for twenty years.

Montreal Builders' Exchange

Brigadier-General Loomis Addresses Meeting, Describing War Conditions and Building Work in France

BRIGADIER General F. O. W. Loomis, C.M.G., D.S.O., now on leave from France, was entertained at luncheon on January 24 by the Montreal Builders' Exchange, of which he is a member. Mr. J. P. Anglin presided over a very large attendance of members, who gave General Loomis a particularly hearty welcome. The Chairman, in alluding to the absence of their guest at the front, assured him that he had not missed a great deal insofar as the building business was concerned. Business had its ups and downs, chiefly downs. Those who had remained at home were doing their best, in the way of giving time and money, to help win the war; some of the firms had put up munitions plants with great expedition, in fact plants were erected with greater speed than was ever dreamed of before the war. The sacrifices of the men at home were, however, as nothing compared with those of the men at the front. General Loomis was one of those who had made a great sacrifice, in giving up his business and his home. He was one of the original officers in Montreal who felt the call and answered it. Their guest was at the Battle of Ypres, leading the 13th Battalion—one of the great Highland battalions of the country—and he was also in the Vimy Ridge engagement, where he had charge of four battalions.

Brig. Gen. Loomis, in the course of his speech, dealt with the war from the contractors' point of view. He referred to the fact that the contractors of the country had made many efforts in the direction of helping the cause for which they were fighting. It was, he continued, hard to say who should and who should not go overseas, and he was convinced that many officers had gone who should have stayed at home. The war involved a tremendous industrial revolution, not of the Empire's seeking, and a struggle for which they were not prepared. Since coming back to Canada he had heard much about the difficulty of getting steel; on the other side the difficulty was to get out of its way. The destruction was almost unbelievable.

The war was really a question of contracting. What a splendid thing it would be to get our contractors overseas? War was a tremendous job, for which contractors were peculiarly fitted, as they were by nature fighters—at least he was always fighting when he was in the business. He had come across many contractors at the front, officers and men, some of whom had given up business to get across. Many of these men had risen from the ranks; they found themselves at home in the work they had to do, and had risen because of their ability to do it. Doing work under shell fire was quite a different thing from doing work under architects' fire. Architects' fire was not so bad at first, but it hurt for a long time afterwards. Gen. Loomis spoke of the facility with which men dug holes under fire, and said there was always an inclination to get into the holes.

Building Work in France

As to building conditions in France, there was a considerable amount of work being done near the firing line in the industrial centres of northern France. The houses were quickly and economically built, the brick being burned on the site. Fifty or sixty houses were put up in a row, and houses in whole villages and towns were constructed exactly alike. The houses were comfortable, with the ground floor and entrances brick paved and tiled. The upper floors were of wood, very economically used. The wood was usually oak and ash; some of the roads, too, were made of beautiful clear oak cut down by Canadian foresters. It was, of course, waste, but war was essentially waste. The speaker concluded by expressing the belief that there was a determination throughout the Empire to fight the war to a finish. Canada, he felt certain, shared in that determination, and was prepared to make even greater sacrifices to that end.

On the motion of Col. Strange, seconded by Mr. W. Rutherford (who has two sons at the front) a vote of thanks was passed to Gen. Loomis, to whom was expressed many hopes that he would return once more safely to Canada.

Mainly Constructional

East and West—From Coast to Coast

About forty miles of the location survey of the Spokane & B. C. railroad line have been completed along the Spokane River since the work began last fall.

The council of Elgin county, Ont., has decided to allow $53,000, or approximately $75 per mile, for the work on the county good roads system during the year 1918.

A 3,000 ton oil flotation plant is to be erected by the Canada Copper Corporation to handle the concentrates from its Copper Mountain properties near Princeton, B.C.

The council of the united counties of Stormont, Dundas and Glengarry, is memorializing the provincial government in regard to the assumption of the River Front road as a provincial highway.

The Allan & McKelvie Engineering Company, Limited, has been incorporated with a capital of $50,000, headquarters at Vancouver, B.C., and will take over the business now carried on under the firm name of "Allan & McKelvie."

The Toronto board of control is unanimous in refusing the application of the railways for permission to build temporary wooden bridges so that the new union station can be used until such time as they are in a position to build the viaduct.

The Edmonton, Dunvegan and B. C. Ry. will apply to Legislature at the next session for an Act authorizing an extension of the railway to the boundary line between the provinces of Alberta and British Columbia, a distance of approximately 65 miles.

The number of permits issued in the city of Vancouver during the month of December is 36, and their estimated value $56,295, as compared with 29 for the same month last year, valued at $286,365. The total for 1917 is 561 permits at a value of $768,255, as against 444 valued at $2,412,889.

The utilities commission of London, Ont., has shown in its statement of proposed expenditures for 1918, a sum of $65,000 for waterworks extension, and $132,000 for the electrical department. The latter appropriation includes $60,000 for the construction of a hydro shop and $25,000 for equipment.

A meeting was recently called in Hepworth, Ont., for the purpose of endeavoring to have the county line from Hepworth to Wiarton and the South Diagonal from Hepworth to Shallow Lake included in the present draft of the good roads system for the counties of Grey and Bruce. As a result, a committee was appointed to interview the council of Grey county at the present session.

It is reported that the British American Nickel Company may possibly abandon their plans for the establishment of a refinery at Sudbury, Ont., owing to the impossibility of developing Hydro power on the French River at a cost of less than $46 per h.p. The report states that they contemplate locating in the Ottawa valley where there is at present developed a surplus of power over local consumption.

A new firm has been incorporated, known as the Engineering and Machine Works of Canada, Limited, which is to take over the business now carried on at St. Catharines, Ont., by the Jenckes Machine Company, Limited. This new concern has a capital of $1,000,000, and its head office is at St. Catharines, Ont. Its charter of incorporation empowers it to carry on the business of foundrymen, machinists and structural metalworkers, etc.

The great reduction in building operations throughout Canada was pointed out by President J. P. Anglin, at the annual meeting of the Montreal Builders' Exchange. The total expenditures on buildings dropped from $185,000,000 in 1912 to $35,000,000 in 1917. The building expenditures in Montreal, Westmount and Maisonneuve dropped from $32,000,000 in 1913 to $6,000,000 last year. President Anglin expressed the belief that the minimum had been reached.

Reports are being circulated to the effect that government assistance may be extended for the establishment of a large electrical smelting and steel plate industry at Vancouver in order that that city may become a steel shipbuilding centre. It is said that the government has agreed to join with the Pacific Steel Company, of Eburne, and the Aetna Iron and Steel Company, of Port Moody, in inviting an eminent outside metallurgist to visit Vancouver and make a final report on the proposal.

A scheme for the establishment of a central heating system in the business section of Owen Sound, Ont., is under discussion. It is proposed to utilize the battery of boilers belonging to the old municipal electric power station which was replaced by the hydro-electric installation at Eugenia Falls. The plant is centrally located and it is believed that it could supply ample heat to every building in the business district and also that the saving in fuel alone in one year would more than pay the cost of installing the system in this section.

In order to permit the working out of an extensive scheme of waterfront improvement on the Grand River, at Port Maitland, Ont., the T. H. & B. Ry. is asking the provincial government to approve of the closing of several roads running through land acquired by the company for improvement along both sides of the river. Residents from two or three of the townships interested, however, raise objections to this action, complaining that their access to the river would be cut off. The government is investigating the matter.

An announcement has recently been made that the Canadian Car & Foundry Company has closed a contract for building steel ships at Fort William, Ont., for the United States to the value of $10,500,000. This will involve the employment of one thousand men, in addition to the fifteen hundred men that will be working on the company's railway car contracts. Tenders have been received for the construction of a new building, 220 by 200 feet, in which the boats will be built, and a marine railway and slip will also be built for launching the boats as they come from the works. The whole of the material for the contract has been arranged for with the United States Government, and shipbuilding will commence in May. This is the second shipbuilding plant in Fort William, the Great Lakes Dredging Company being now engaged on the construction of wooden freight steamers.

At the annual meeting of the London Builders' Exchange, officers for 1918 were elected as follows: President, Harry Hayman; first vice-president, L. A. Ross; second vice-president, Ed. Gerry; treasurer, Thos. A. Jones; board of directors, Messrs. A. C. Nobbs, E. R. Dennis, Thos. Beer, Ben Noble, T. R. Wright; auditors, Messrs. Pace and James Whittaker. Messrs. Moran, Nobbs, Hayman, Noble and Gould were chosen as delegates to the provincial convention which is to be held in Galt next June.

The Property Committee of the Toronto Board of Education has included in its 1918 estimates a sum of $150,000 for the erection of a new school of 15 to 18 rooms to replace the old building on Rose Avenue. It is to be a two-storey structure, but in order to compare the cost with a three-storey building, tenders will be called for both types. The estimates also provide for the erection of a 12-roomed school on the Glenholme Ave. site at a cost of $100,000, and a $70,000 eight-roomed school on Glengrove Ave.

An association known as the Engineering and Technical Institute of British Columbia is making application for incorporation, to the Legislative Assembly of British Columbia. Its avowed objects are, "to promote and increase the knowledge, skill and proficiency of its members in all things relating to the architectural, engineering, surveying and technical profession and to that end to establish and conduct examinations and prescribe such tests of competency and moral character as may be thought expedient and to grant certificates of membership to those approved of, and to purchase or otherwise acquire and hold real and personal property for the purpose of the institute," etc.

Keen interest is being displayed in the good roads movement in Kent County, Ont. Recently a meeting of the council was held to discuss the question, at which Mr. W. A. McLean, Deputy Minister of Highways, was present. Mr. McLean addressed the council, outlining the government's plan for assisting the counties to improve their roads, and explaining the arrangement with regard to the suburban area highways, toward the construction of which the cities and towns contribute a share of the expenditure. He did not urge any heavy expenditures just at present, owing to war conditions, and also stated that it usually takes a year or two to get the machinery required by a good roads scheme working smoothly.

A reort covering the various works carried out by the engineering department of the district of North Vancouver during 1917 has been prepared by Acting District Engineer Sharpe and was recently presented to the ratepayers. The most important works were the rocking of the Capilano road for a distance of about a mile, at a cost approaching $5,000, and the construction and macadamizing of the Dollar road at a cost of $10,000. Fromme road in Lynn Valley was also macadamized for a distance of 1,459 ft. at a cost of $1,723. Mr. Sharpe believed this year would be one in which strict economy would have to be practised. With the exception of a possibility of constructing a water system for East Seymour district, the present year's programme would consist mainly of maintenance work.

It is reported that the Dominion Steel Corporation propose to erect a new steel mill at Sydney, N.S., for the manufacture of plates for steel shipbuilding. The establishment of this industry, which will entail an expenditure of several million dollars, is contingent on the Dominion Government's shipbuilding policy being put into effect. It is also stated that the government has received tentative offers from large United States companies desiring to engage in the manufacture of steel for Canadian ships. These companies, however, require bonuses and concessions before taking up the manufacture of steel products on a large scale in Canada. The government, it is understood, has not yet decided to bonus corporations desiring to engage in the work, though it will receive propositions and prices submitted for consideration.

G. R. Marston, road superintendent for the county of Norfolk, Ont., recently submitted an exhaustive report to the county council with regard to the good roads system. This contained data showing the equalized assessment in the various townships and the mileage assumed in each under the county system. Figures on the last three years' road work in the county were also given, covering both statute labor and the general expenditure on roads and bridges, and the total annual expenditure is shown as $53,090. Of this amount, the superintendent estimated that the proportional expenditure on the mileage now assumed by the county was $18,021 annually, and on this he bases his estimate of the cost of maintaining the county system for the year 1918. Mr. Marston's report concluded with remarks regarding the necessary work to be done on the various roads. The chief fault he dwelt upon was that the shoulders were too high thus keeping the water in the centre. He suggests the cutting away of said shoulders, and not scraping them into the centre as heretofore.

Personals

Mr. Johnston, reeve of Keppel Township, has been appointed superintendent of roads for the County of Grey, Ont., under the good roads by-law recently adopted.

Announcement has been made of the marriage of Mr. Charles A. Paquet, general manager of the General Car and Machinery Works, Limited, of Montmagny, with Miss Jeanne Langlais, of Quebec, on January 28th.

Mr. Gordon Grant, who for the last six years has been chief engineer of the National Transcontinental Railway, has been appointed expert adviser to the Minister of Railways, this being a new office established by the government.

Lieut. Col. Blair Ripley, Mem. Can. Soc. C. E., Toronto, has been awarded the D.S.O. Col. Ripley, who has been twice mentioned in despatches, is the officer commanding the first Overseas Canadian Railway Construction Battalion.

Major J. Ivan McSloy, a 1910 graduate of the Faculty of Applied Science and Engineering of the University of Toronto, has recently returned from the front. He enlisted during the early days of the war as a lieutenant in the Canadian Feld Artillery and was attached with the rank of captain to the 14th Battery at the Exhibition Camp in the winter of 1914-15, later being made adjutant of the 4th Brigade. Major McSloy has been serving in France with a battery of the Canadian Field Artillery.

Obituary

Mr. T. F. Sinclair, of Vancouver, a well-known contractor, passed away recently at his home in that city. The New Westminster waterworks plant is one undertaking which was carried out by Mr. Sinclair. He also built a section of the C. P. R. through the mountains and engaged in many other important undertakings.

Mr. Marcel J. P. Beullac, Mem. Can. Soc. C. E., a member of the engineering staff of the Dominion Bridge Company, Montreal, died suddenly on January 27, aged 46. Mr. Beullac was also a special lecturer on structural engineering at McGill University. He was a native of France, and when the war broke out offered his services to our ally. Some months ago he returned to this country on leave of absence in connection with war work.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Grand'Mere Que.
Town Council contemplate the construction of a few thousand feet of concrete sidewalk in the spring. Engineer, Chas. Gelinas.

Parry Sound, Ont.
Town Council contemplate the construction of roads. Mayor, H. M. Purvis.

Victoria, B.C.
Plans have been prepared for a $50,000 irrigation system from Shelbourne Street to Saanich for the Victoria and Saanich Councils. Engineer, C. D. Rust, Victoria.

CONTRACTS AWARDED

Winnipeg, Man.
Thos. Kelly & Sons, Lindsay Bldg., have the general contract for reinforced concrete pipe line, etc., costing $482.626 for the Greater Winnipeg Water District, 501 Tribune Bldg.

C. G. Anderson, Kenora, has the contract for gate house and intake at Waugh for the Greater Winnipeg Water District, 501 Tribune Bldg.

Railroads, Bridges and Wharves

Alberta, Province of
The Edmonton, Dunvegan & British Columbia Railway, Edmonton, will apply to the Government for permission to extend tracks 65 miles west. Engineer, W. R. Smith, E. D. & B. C. Station.

Halifax, N.S.
Department of Public Works, Dominion Government, will erect a freight shed. Secretary, R. C. Desrochers, Ottawa.

Simcoe County, Ont.
County Council contemplate the erection of a $3,000 concrete bridge over Petty River. Engineer, J. Wilson.

Smithers, B.C.
The Grand Trunk Pacific Railway, head office, Montreal, contemplate the erection of an $18,000 station this spring. Local superintendent, A. Kilpatrick, Smithers.

CONTRACTS AWARDED

Alberta, Province of
Mr. Sims, Red Deer, has the general contract for "Cluny" bridge for the Department of Public Works, Parliament Buildings.

Carleton County, Ont.
The Ontario Bridge Co., Ltd., Crown Office Bldg., Toronto, have the general contract for bridge for the County Council.

Chatham Township, Ont.
The Chatham Dredging Co., Chatham, have the contract for dredging costing $8,000, and A. Williston, Wallaceburg, the contract for bridges costing $1.425 for the Town Council.

Halifax-Nord Township, Que.
The Dominion Bridge Co., Ltd., Dominion Station, Lachine, have the steel contract in connection with the erection of $25,000 concrete and steel bridge for the Municipal Council.

Montreal, Que.
The Phoenix Bridge & Iron Works, Ltd., 83 Colborne St., have been awarded the contract for the erection of a bridge on Godefray River, between Ste. Angele de Laval and St. Gregoire le Grand, at a cost of $35,000.

St. Henri de Lauzon, Que.
Jos. Longchamps, St. Henri, has the contract for substructure, abutments and the Phoenix Bridge & Iron Works, Ltd., 83 Colborne St., Montreal, the contract for superstructure for $13,000 concrete and steel bridge for the Municipal Council.

Public Buildings, Churches and Schools

Belleville, Ont.
The School Board have secured a site on North Front Street on which they contemplate erecting a school. Secretary, W. J. Diamond.

Coronation, Alta.
Plans and specifications with the Department of Education and the secretary-treasurer, J. F. Bernardin, Coronation, who will receive tenders until noon, February 18, for the erection of a school for Federal School District No. 3566.

Crowland Township, Ont.
Work will be started soon on police station and township clerk's office costing $7,000 for the Township Council. Township Clerk, H. L. Pratt, Welland.

Halifax, N.S.
Tenders received by the secretary, R. C. Desrochers, Ottawa, until 4 p.m., February 14, for the reconstruction of steel roof trusses for drill hall for the Department of Public Works, Dominion Government. Each tender must be accompanied by accepted cheque for $1,500.

City Council contemplate the erection of a temporary hospital. Chairman, Dr. N. E. MacKay.

The Halifax Exhibition Committee plan to rebuild exhibition buildings, etc. Address, Mayor P. F. Martin.

The Reconstruction Committee contemplate the erection of a two or three-storey administration building. Chairman, G. F. Pearson.

London, Ont.
Board of Governors contemplate installation of heating system in the Western University. President, Dr. E. E. Braithwaite.

Ottawa, Ont.
Separate tenders are being received by the architects, J. A. Pearson and J. O. Marchand, Centre Block, until March 18, for rolled steel casements, bronze covered frames, etc., for the Parliament Buildings. Plans and specifications at the office of the general contractors, P. Lyall & Sons Construction Co., Ltd., Parliament Buildings.

Toronto, Ont.
St. Matthews' Church Congregation contemplate the erection of a rectory on First Avenue. Members of the committee, W. F. Summerhayes, 651 Broadview Ave.

Chief Librarian Locke has recommended the erection of an addition to library building on George Street by the Public Library Board, 226 College Street.

York County, Ont.
In his annual report Mr. R. P. Coulson, Inspector of the Childrens' Aid Society recommends that the County erect a home for the use of the Society.

CONTRACTS AWARDED

Fingal, Ont.
The following contracts have been awarded in connection with the erection of a $16,000 school for the Public School Board:—General contract, Edgar H. Horton, 82 Myrtle St., St. Thomas; carpentry, D. L. Shafer, 131 Curtis Street, St. Thomas; heating, G. W. Blanchard, 632 Talbot Street, St. Thomas; roofing, Chas. Riddle, 119 Wellington Street.

Grantham Township, Ont.
Fred Clatterbuck has the plastering, and Sandham & Roberts, 237 St. Paul St., St. Catharines, the electrical work for $18,000 school building for School Section No. 7.

Quebec, Que
Elzear Bertrand, 288 Third Avenue, Limoilou, has the general contract for $9,000 frame chapel for the parish of Limoilou.

St. Damien de Buckland, Que.
Alyre Metivier has the general contract and P. J. Labrecque, 44 Fraser Street, Levis, the plastering contract for $65,000 extension to Convent.

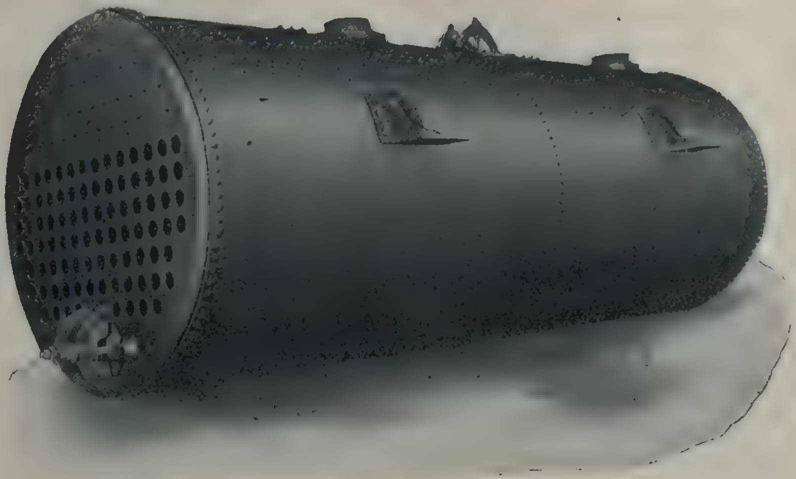
Sydney, N.S.
Falconer & McDonald Ltd., Davidson Street, Halifax, have the general contract for $40,000 church for the Union Baptist Congregation.

Vancouver, B.C.
Baynes & Horie 836 Howe St., have the general contract for $35,000 building for the McGill Uinversity.

Business Buildings and Industrial Plants

Brantford, Ont.
Alex. Howarth, 87-89 Dalhousie St., contemplates conversion of hotel into three stores and ten apartments at a cost of $6,000. Tenders will be called about

Boilers



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Save Engineers for War Service

The following extract from an address by William Howard Taft, former president of the United States, to the American Society of Mechanical Engineers, emphasizes the great need for conserving the human resources in engineering.

You engineers, all, constitute one of the two professions that are indispensable to the country in carrying on of the struggle in which the people of the United States are now about to devote themselves; yours and the medical profession. You as the constructors of all material and all the equipment, of which so much is needed now in modern warfare to make effective the work of our boys at the front, and the medical profession to furnish as far as may be the aid in restoring to the ranks those whom the fortunes of war disable.

We have a conscription law, which is justified on the ground that it was a selective draft. We know that under that law those whose services can be most useful to the country in the trenches will be sent over, and those whose services can be most useful to the country in preparing and in saving men and materials should be retained in those places, so that they might not be wasted in the trenches and elsewhere, in which others could do just as good work as they—others who could not discharge the services required of engineers or physicians. We should all profit by the mistakes which England made in allowing her doctors and her medical students and her engineers and engineering students to go into the ranks and be sacrificed. Because of this England has reduced the supply of those indispensable persons so that she is embarrassed, and greatly embarrassed.

Congress and the Administration should see to it that the medical students and the engineering students should be reserved for the work for which they are particularly fitted; that the engineer students and the medical students should be required to go on and complete their preparation as engineers and physicians, so that they may become engineers and doctors, and may then be gathered into the service.

Uniform Application of Hot Tar and Sand Road Grout

On some bituminous macadam roads built by the Massachusetts Highway Commission the foundation course of 2 and 2½ in. stone is grouted with a mixture of hot pitch and sand, after which another course of smaller stone is applied and grouted and receives a finishing coat of hot pitch and sand, covered with fine stone well rolled.

In some cases the sand and tar were heated and then mixed in a sloping box mounted on wheels and discharging through a flexible pipe with a flat nozzle delivering to the road surface.

A method very recently developed enabled the tar and sand to be applied with great uniformity and in the proper amount, so that all voids were filled and no excess was used. This was accomplished by spanning the roadway with two transverse plank bridges supported on the edges of the road and on a crown plank. The ends of 2 in. longitudinal planks were supported on the transverse bridges, making a movable platform that commanded the whole surface. A flat nose bucket with a nozzle about 8 in. wide was filled with the hot mixture of tar and sand, and being held close to the edge of the longitudinal plank, the grout was continuously poured over the surface of the road as the man carrying the bucket walked uniformly from one end to the other of the plank at a gait just sufficient to enable the contents of the bucket to be poured out at one trip. The bucket was then refilled, the longitudinal plank moved transversely on the bridge to the edge of the grouting space, and another section grouted, and so on until the full width of the road was covered with about 2 gallons of grout per square yard of surface.

Protecting Old Stone Masonry with Cement-Gun Mortar

About the first recorded instance of the use of portland cement in American railway structures was the covering of old stone masonry culverts on the Erie Railroad with concrete. The frequent repointing of stone is alone sufficient justification for covering it with a cement mortar slab, in many cases; but when the stone is of a character that slowly disintegrates by "weathering," there is only one ultimate solution of the problem, namely, surfacing with cement mortar or concrete. Recently a rubble arch bridge near Lancaster, Pa., was surfaced with cement mortar applied with a cement gun. The bridge was built more than a century ago, and had disintegrated badly. Loose mortar was picked out of the joints and wire mesh was fastened to the face of the masonry with boat spikes driven into the joints. Then a 1:3 mortar was shot on, covering the surface to a thickness of 2 inches. The Dewey Cement-Gun Construction Co., of Allentown, Pa., covered 11,000 square feet in 14 days of work with the "gun," or 800 square efet per day.

Deepest American Drill Hole

A diamond-drill hole in Sussex County, New Jersey, 4,920 feet deep, has recently been completed by the contract drilling forces of the Sullivan Machinery Company. A 2-inch diameter core was removed to a depth of 1,600 feet, beyond which tools removing a 1⅜-inch core were used to the completion of the hole. When the depth of 4,900 feet was reached the long line of rods required for drilling weighed 13 tons, and it took eight hours' steady work for hoisting them out, replacing them, and resuming drilling. It is said that the hole showed no deviation from the perpendicular. It required 20 months to complete the hole, which is 1,700 feet deeper than the deepest previous hole of which there is any record in North America. Only three or four diamond-drill holes have been put down in this country, it is said, exceeding 3,000 feet in depth.

Motor Truck on Rails Hauls Concrete Cars

The ubiquitous Ford seems to relish abuses, as may be seen in the accompanying view, where one of the multitude is hauling one yard of concrete on standard-gauge railway construction. No essential modification of the car was necessary in this case, the tires simply being removed, and flanges bolted to the rim. The necessary drawbars were bolted to the frame of the automobile itself, and the arrangement has proved adequate to the task of drawing two yards of dirt.

Clearing Sewer Pipes

Bradford, England, has a sewer five miles long, with a drop of 70 feet in distance. The grade is not uniform. As the sewage is loaded with heavy, solid matter, the flow was not what is should have been. The city did not want to resort to pumping because of the expense. One of the city engineers hit upon the idea of using compressed air at a pressure of 80 pounds and discharging it at regular intervals into the sewer. The plan was carried out with great success. It has been done for some time now without a recurrence of the difficulty.

Shattering Rock for Steam Shovel Excavation

In wet rock a 40 to 50 per cent. low freezing gelatine is recommended and in dry rock a low-freezing dynamite. In tight, hard bottom the gelatine is best, because its great density enables a larger weight of explosive to be concentrated in the bottom of a hole of a given diameter.

Occasionally the charges fail to explode and time is lost waiting to recover the charges, or danger is incurred if this precaution is neglected. These troubles may be avoided by deeper holes and by using more care in loading and testing the caps. Strong detonators should always be used to get the maximum efficiency fro many explosive.

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The Fuel Saving Mandate

EASTERN Canada, acting upon the order of the Fuel Controller, will have experienced, when this issue is off the press, a general tie-up of industry designed to supplement the general movement to conserve coal. At the time of writing we cannot say what will be the effect of the order, nor can we forecast to what degree a saving in coal has resulted. Criticism there has naturally been, but certain it is that the order, drastic though it may superficially appear, will be obeyed. Reports from industries throughout the district defined in the mandate indicate a cheerful willingness and, indeed, a determination to uphold the Fuel Controller's wishes. While there are people who give vent, perhaps, to wild tirades against the fuel administration, such criticism is largely from those who know little of the real situation, or whose demand for special consideration is born of selfishness in their desire to maintain their normal industrial revenue. In nearly one hundred per cent. of the cases, industry will take its three-day shutdown with cheerful acceptance.

It will be interesting to determine to what extent a tie-up of industry and business will relieve the coal scarcity by cutting down consumption, or give relief to the railway congestion that, principally, we believe, is responsible for the delay in arrival of coal. Coal will no doubt be saved, for what is not used one day is available for the next, and a three-day shutdown, when as complete as detailed in the Fuel Controller's decree, ought to and will show a favorable result.

This country has much reason to be thankful for the condition in which it finds itself in regard to the coal scarcity. With the United States, our source of supply, itself deeply in the throes of a fuel famine, Canada may be particularly grateful for receiving a supply at least as adequate as that doled out to themselves. The United States has given freely of its resources. This being the case it is meet that Canada should exercise the same degree of control and should undergo the same deprivations. If a five-day paralysis of industry in the United States has proved necessary for the relief of an unprecedented situation, to what can we object in a three-day order less stringent in the nature of its application and less drastic in its consequences? Our Fuel Controller, we have every reason to suppose, has viewed the whole situation in perspective; he is able to collectively size up the need of fuel conservation more adequately than any other individual with obviously limited knowledge; he has had the benefit, further, of intimate consultation with the Fuel Administrator of the United States and what he decrees may, therefore, be accepted as in the best mutual interests of all concerned. It is our plain duty to patriotically observe such mandates as may from time to time be thought necessary to relieve an impending coal famine. The Fuel Controller can be assured of co-operation, then, in doing his best to remedy a condition that, we hope, may not again soon confront the people of Eastern Canada.

Canadian Experience with Bituminous Concrete Roads

IN an article recently read by Mr. Julius Adler, engineer of tests, Pennsylvania State Highway Department, before the American Association for the Advancement of Science, and which was reproduced in the Contract Record of January 23, the following statement, having reference to bituminous concrete roadway construction, appears:

"On the other hand, attempts to re-surface old macadam roads with bituminous mixtures, even where the mineral aggregate is scientifically graded and the bitumen of selected consistency and quality, have been found not to meet with unfailing success."

In fairness to this type of road it should be pointed out that, mild as this statement is, so far as Canadian experience goes it is not correct to modify in any way the simple word "success." As an example we may point to University Avenue, Toronto, one of the best known and most talked of roads on the Continent. This has been down about five years and has not cost, so far as we can learn, one single cent for repairs.

Another example is the Vancouver-Eburne road, six miles in length, of the same type of construction as University Avenue, noted above, which was constructed on a new macadam foundation, this foundation certainly being inferior to an old, consolidated foundation, and which has been taking traffic for the last seven years and is in excellent shape. Indeed, it may be said that road engineers in general deem the bituminous concrete, on a proper foundation, the last word in road construction.

That the opinion expressed by Mr. Adler is not borne out by authorities on this side of the line is best evidenced by the statements of engineers and road superintendents who have had intimate knowledge of this material. A wider knowledge of practical conditions would doubtless have led him to modify his statement.

Quebec Municipal Affairs Under Government Control

A BILL has been introduced in the legislative assembly of the province of Quebec, authorizing the formation of a department of Municipal Affairs. This department shall be under the direction of a minister of municipal affairs, with deputy minister and other officers. This department will have oversight of the administration and operation of the laws respecting municipal affairs, and more particularly with reference to bonds sold by municipalities and their method of repayment. For example, municipalities and school corporations will be obliged to create a sinking fund sufficient to take care of the loan at date of maturity. This fund is to be deposited with the provincial treasurer and will draw interest at 3½ per cent. At maturity the bonds are thus redeemed by the government instead of by the municipality that contracted the debt. The term of years for which the loan is to run will also be determined by this department and the length of time will depend upon the stability of the work for which the money is expended. Finally, all municipalities must keep proper accounts to be rendered at regular intervals to the minister of municipal affairs.

A Scheme for Pensioning Employees

FRIENDLY relations between capital and labor is a powerful factor in the success of any enterprise. And the advantage is not by any means all on the side of the employer. Any employee who has confidence and confides in his employer is happier, does better work, and, in consequence, advances more rapidly. The advantages are mutual.

In one form or another profit sharing with the employee has been tried out in various countries. Of course, the standard objection is that the average employee is satisfied enough to accept his share of the profits in the fat years, but is not willing to take the loss in the lean years. In the main, however, any attempt to take employees into closer confidence and relationship has met with gratifying response. Difficult as it may be to please everyone in the rank and file of any large organization, experience shows that the vast majority appreciate an honest attempt on the part of employers to improve their working conditions and they repay the compliment in greater loyalty and industry.

In this connection it is a pleasure to note the announcement on another page of this issue, by the Consolidated Rubber Company, of the inauguration of a Pension Fund to take care of their faithful employees. In the main the scheme is as follows:

The administration of the Pension Fund shall be in the hands of a committee of not less than five, nor more than seven, appointed by the Board of Directors to serve during its pleasure. All employees of the company, engaged in any capacity whatever, and wherever located, are eligible for pension. At the age of sixty, or sixty-five for men, and fifty-five or sixty for women, employees have the option of retiring on pension.

The amount of pension is to be equal to 1 per cent. of the average year's wage for ten years prior to retiring, multiplied by the number of years the employee has been in the service of the company. Thus, an employee whose average wage has been $1,000 for ten years, and who has been in the service of the company for thirty years, would receive 1 per cent. of $1,000, multiplied by 30, or $300 a year.

Provisions are made for permanent illness and other contingencies such as pension being received by the employee from another source. The plan is announced to take effect January 1, 1918.

Progress of Safety Propaganda

REPORTS read at the fourth annual meeting of the Ontario Safety League, held on Monday, February 4, in the council chamber of the Board of Trade, Toronto, showed that a great deal had been accomplished during the past twelve months along educative lines in the matter of preventing accidents to the travelling and manufacturing public.

A few figures from the distribution of "safety literature" report are evidence of the widespread nature of this portion of the work. Cards sent to drivers of vehicles, 90,000; special cards to motorists, 10,000; letters to parents, 100,000; electric railway bulletins, 11,000; large cards in street cars, 1,700; gummed seals for the use of firms in sending out correspondence, 330,000.

A most interesting part of the campaign for safeguarding the public is that in connection with the schools; the Board of Education co-operating with the League by printing safety slogans on all exercise and other note books. In addition the annual essay contest on "How children may help to avoid motor accidents," with $50 in prizes, was conducted.

Legislation to Improve Montreal Government

SIR Lomer Gouin, premier of the Province of Quebec, has submitted to the Private Bills Committee of the Legislative Assembly, a plan for the government of Montreal which will most likely be authorized by the provincial legislature His proposals are as follows:

That Montreal retain its twenty wards, to be represented in the Council by twenty Aldermen; that an Administration Commission, composed of five members, be named, composed of the City Attorney of Montreal, the City Auditor and the City Treasurer, these three to be named for life, and two Commissioners named by the Lieutenant-Governor-in-Council, for a term of four years. The decisions of this Commission could be rejected only by a two-thirds or a three-quarters vote of the Council, ratified by the Lieutenant-Governor-in-Council, and the same would apply to the removal from office of any member of the Commission.

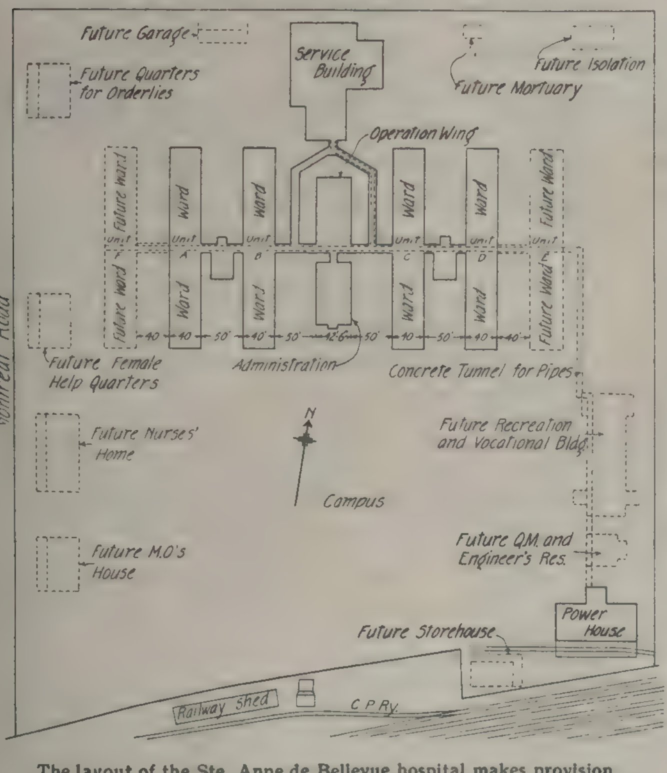
The members of the Commission would sit in the Council and have a vote.

The Ste. Anne de Bellevue military hospital, the largest in Quebec, is simply and inexpensively constructed according to the standards of the Military Hospitals Commission.

Military Hospitals Commission Very Active

Seventy Works Under Way at Present with No Limit in Sight —This Article Describes the Ste. Anne de Bellevue Hospital

To provide the proper care and medical surveillance for the large number of soldiers returned from overseas, the Military Hospitals Commission has had to erect many new hospitals or make considerable structural alterations to buildings originally intended for other purposes. So extensive have these activities become that at the present time the commission is, or rather controls, the largest building organization in the country. Seventy works for the Military Hospitals Commission are under way at present, and it is authoritatively stated that the work of building military hospitals in Canada has by no means reached its limit yet. Within a period of eleven months it is estimated that there has been constructed, either in the form of new hospitals or as adaptations of existing buildings, a floor area to the extent of 65 acres.



The layout of the Ste. Anne de Bellevue hospital makes provision for future extensions.

In view of these widespread building activities, a works department has been formed, the administration of which is under the direction of Mr. J. H. W. Bower as general superintendent of works. Captain W. L. Simons is directing and supervising the planning and architecture of the buildings. The erections and alterations of all hospitals, schools, and training institutions to be used by the Military Hospitals Commission for returned soldiers come under the direct supervision of this department of the organization. By undertaking the work themselves, rather than by employing outside architects and overseers, it is stated that a very considerable sum has been saved.

The Largest Military Hospital in Quebec

One of the many projects being undertaken under the direction of the works department is the hospital at Ste. Anne de Bellevue, P.Q., the largest military hospital in the province. The following article is descriptive of the work in this institution. There is nothing unusual in either architecture or construction, the designs being simple and calling for straightaway methods. Simplicity, coupled with completeness of equipment, characterizes the whole scheme. The standards laid down by the commision for all its work have been adopted in the Ste. Anne de Bellevue hospital. These call for a simple design and lend themselves to rapid and inexpensive construction, at the same time having ample provision for the most up-to-date equipment and accommodation.

The Ste. Anne de Bellevue hospital is similar in design to that at Halifax. It is interesting to note that this latter institution during the recent disaster provided accommodation for 1,600 persons in a space originally intended to house 300. In the early stages following the disaster 6,000 meals were served daily to refugees from a kitchen which was designed to have a capacity of about 300 persons per meal. This fact is pointed out as an outstanding feature in demonstrating the efficient manner in which the kitchen and other parts of the military hospitals are designed and equipped.

To Be Extended in the Future

The first contract, but not all, in connection with the erection of the Ste. Anne de Bellevue hospital was let on October 27. Contracts for several other buildings to be constructed on the site are pending. The work contracted for and now under construction comprises four ward buildings, administration building, operating room, kitchen and dining-room. Extensions are contemplated, although these are not yet contracted for. Future plans call for a vocational building for the re-education of patients, a recreation building for gymnastic and amusement purposes, a nurses' home for a complete staff of nurses and masseuses, an orderly building as living quarters for the male help, a building for female help, a medical officers' residence, and a small isolation hospital and mortuary.

The layout of the hospital is shown in the accompanying plan, while the photographs give an indication of the general type of construction. The four ward buildings are each 250 ft. in length, 40 ft. wide, and two storeys in height. The administration building and the operating wing are each 80 ft. x 40 ft. and three storeys high. The latter includes the most up-to-date equipment for operative and massage treatments and rooms for hydro-therapeutic and electro hydro-therapeutic treatments. The dining-room has a seating capacity for 600 persons. Forty beds, with modern toilet facilities, are contained in each ward.

Frame Construction

The buildings are frame construction, on foundations consisting of concrete piers as far as ground-floor level. The walls are 2 x 6 in. studding, sheeted diagonally outside and in with ⅞ in. boarding. The exterior is covered with two-ply waterproof paper, furring, wire lath and stucco, while the interior is finished with asbestos board. Four-ply felt and gravel is used for the roof.

The buildings are to be lighted and heated from a special power-house, which will generate its own power for the elevator and electric lighting services. The lighting throughout is electric, with semi-direct fixtures. A concrete tunnel from the power-house to the other buildings will convey the electric conduits and heating pipes.

The water supply will be furnished by the corporation of Ste. Anne de Bellevue, the estimated consumption being 50,000 gallons per day. Fire protection will be taken care of by standpipes in buildings and hydrants on the ground. In the event of fire, pressure will be augmented by booster pumps.

The buildings are of frame construction.

Messrs. E. G. M. Cape & Co., Ltd., Montreal, are the general contractors for the building.

Keeping Country Roads Open in Winter Time

Motor Trucks with Snow Plows Keep 225 Mile Stretch Clear of Snow —Three Ton Wooden Rollers Make Passable Road at $2.00 a Mile

BY systematic measures for the removal of snow, many country roads are now being opened during the winter season for motor as well as horse traffic. No very stringent attempts have hitherto been made to keep rural highways, even though hard surfaced, available for more than purely localized use. However, since long stretches of suburban and interurban roads of an improved type are becoming common, there is a greater need for the removal of restrictions to winter travel. Obviously, there are great difficulties in the way of keeping a clear roadway in the winter time, and the methods to be used depend, of course, on local and weather conditions. Inasmuch as an article on snow cleaning methods is timely and of interest to road engineers, we present below a few experiences described by road engineers of the United States. The methods are largely applicable to rural highways.

Rollers Compact Snow

Mr. Charles A. French, city engineer of Laconia, N.H., states that snow rollers have been used for many years to compact the snow, more especially on outlying roads, but also on the city streets. The methods are described as follows:

"They are used after each snow storm when there is a depth of five inches or more or when roads are drifting badly. When drifting occurs the roller must be accompanied by a few shovellers who level the tops of the drifts and "sidling" places so that the roller will leave a fairly level cross section and not leave chuck holes.

"Rolling makes a solid snow path about eleven feet wide into which heavy loads of logs will not sink. It gradually builds up the roads through cuts and wherever drifting occurs so that the snow blows over rather than into the roads. Turning out is made easy but care must be used not to get off the rolled track. We have hard snow paths over drifts six and eight feet deep which are very satisfactory to the farmers and lumbermen.

"When the roads begin to "slump" or grow soft in the spring it is necessary to "machine out" the deeper drifts with road machines or graders, mounted on runners instead of wheels. Very little shovelling is required and much is saved where deep snow and fairly steady cold weather occur.

Rollers of Wood

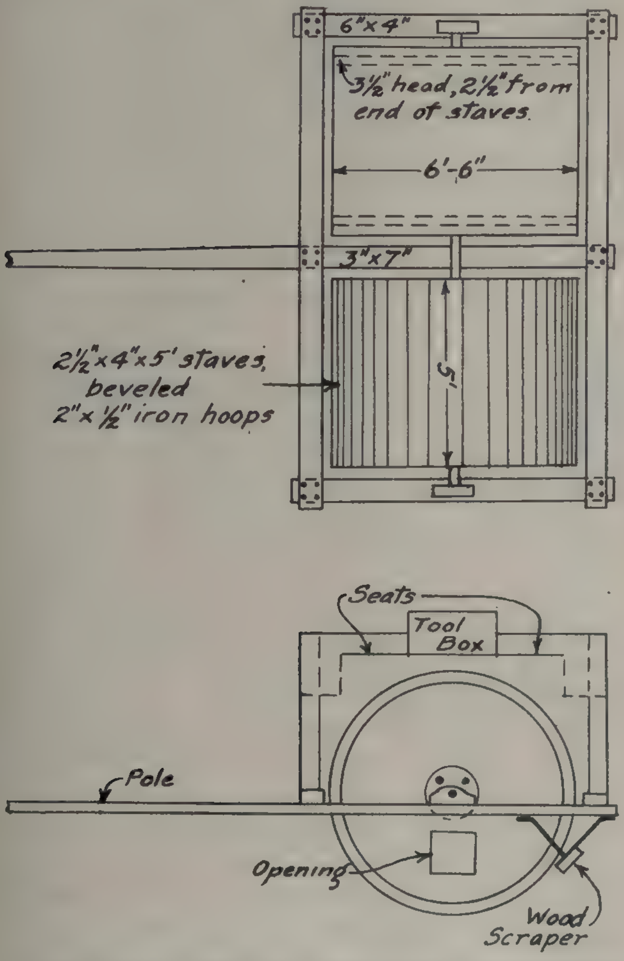
Our rollers are built after our own model and weigh, I suppose, from three to four tons.

"The rollers consist of two wooden rolls about six and one-half feet in diameter and five feet long, mounted on a hardwood frame of substantial construction

(4 in. by 6 in. oak). The rolls are built of oak staves 3 in. x 4 in., assembled around circular heads and held in place by screws to the heads, and a ½ in. x 2 in. iron hoop shrunk on each head. The heads are built of 2 in. pine plank in two layers laid at right angles with each other and screwed together. The rolls are mounted on the frame by means of trunnions bolted to the heads and running in boxes on the frames. The pole is of 3 in. x 7 in. ash tapered and bolted to the frame at the front and back and running clear through. The roller is surmounted by box seats resting on the frame. It seats two men, one at the front and one at the back, and two more can ride on top of the tool box.

"Six heavy horses are required, two abreast. Two are hitched on the pole and two on a detachable lead pole and two leaders on whiffletrees attached to the lead pole.

"A roller outfitted as above will cover from ten to fifteen miles a day, depending on conditions. The cost, of course, depends on the number of shovellers. As an average basis take one foot of snow; three pairs of horses with drivers at $6.00 each and two extra men at $2.50 each makes a daily cost of $23. If eleven and one-half miles are covered the cost is $2 per mile, which, I think, is about our average. We require one man to drive six horses, and the other two drivers to shovel when necessary.



This outfit gives satisfaction in keeping roads clear in winter time.

"Rolling is the most satisfactory method of breaking roads we have ever tried, and it gives the best satisfaction to road users."

Plows on Lincoln Highway

Mr. William D. Uhler, chief engineer of the Pennsylvania State Highway Department, describes as follows the snow cleaning work on the Lincoln Highway. The method is to start the snow plows to work as soon as the snow reaches a depth of a couple of inches:

"We are using two kinds of plows; one is a snow plow attachment to put on the front of a motor truck, which pushes the snow aside, this plow being manufactured by the Good Roads Machinery Company. The other method is to use an ordinary four-wheeled road machine with a short tongue, hooked on behind motor trucks, and plow or push the snow to one side. Of course, if there are any heavy drifts it may be necessary to use a certain amount of hand labor, but it may be possible, if the drifting is in spots, to first break a road through the heavy banks with teams, in order to enable the motor trucks to get through with the plows and keep them working, plowing to a certain depth each drift until the snow is all removed. Our costs up to January first were approximately $31 per mile of road.

Further details of the work in Pennsylvania are given in the following article by Geo. H. Biles, Second Deputy State Highway Commissioner:

The State of Pennsylvania is co-operating with the national government in keeping an artery of travel across the state open and free from snow for the United States army transport trains operating between the Central West and the seaboard. This route in our state extends from the Ohio state line, via Beaver Falls, Pittsburg, Greensburg, Bedford, McConnellsburg, Chambersburg, Gettysburg, and Littlestown to the Maryland state line, a distance of approximately 225 miles.

A system of operation for handling this work has been established by the maintenance division of the state highway department, which will be described briefly: Through arrangements made with the weather bureau office at Pittsburg, weather forecasts are wired to the main office of the state highway department, by which conditions can be anticipated and instructions issued immediately to the various districts to organize men and equipment for action. The field organization of the state highway department consists of the assistant engineer, who has control of all work in several counties, usually about five in number, followed by the superintendent of highways of the county, who has charge of all maintenance work, and under these men come the gang foremen, patrolmen, labor, etc. This organization has complete charge of this work in their respective counties, and is under the direction of the second deputy commissioner in charge of maintenance.

Motor Trucks With Snow Plows

Stationed at the larger towns along the line of this route are motor trucks equipped with snow-plow attachments, road machines, drags, shovels, etc. The patrol system of about 34 men is engaged continuously in repairing and patrolling this highway, each man looking after his particular section; and this plan is a most important factor in reporting emergency conditions of consequence to the district head or superintendent, who reports by wire or phone to the main office direct. The caretaker is empowered to organize forces, if need be, to take care of conditions until the arrival of the superintendent. If the conditions are unusual the superintendent reports by phone to the assistant engineer, who arranges to inspect and handle the work accordingly.

The report made by the caretaker is either by wire or telegram, which is followed by a postal card report form, giving details and addressed to the main office at Harrisburg. This information is charted as soon as received, and the same practice is followed upon the completion of the work. If the drifts are abnormal and the road is not opened within twenty-four hours, the office must be advised by wire, and in this way headquarters is in direct touch and control of the entire route at all times.

Cut Through Heavy Drifts

The first snowstorm of consequence occurred December 7 and 8, and was general over the entire route, and for many miles drifts averaged three to six feet in depth. The work was begun by breaking a track through the drifts with teams and drags. This was followed by the road machines, or trucks with the plow attachments and shovelers. Turnouts were made along the line, and thereafter the road widened out to a width of between 14 and 16 feet, depending upon the location. The entire travelable width of roadway was finally opened in order that traffic would not track and cut through the road surface during periods of freezing and thawing. The snow at first was removed to within three inches of the road surface, and what did not melt was afterward removed entirely. Through the deep cuts, after a track was broken, it was necessary to resort to shoveling.

As soon as any section of the road was opened, shovelers followed, cutting openings from the side to the ditches at various intervals along the road. When this work was completed the road was again turned over to the caretaker, or patrolman, to look after the drainage details.

Snow Fences Desirable

From observations taken since 1913 it has been found that at certain locations the construction of snow fences would be advantageous and economical, and whereas it was impossible to put all the necessary fence in place this season, some of it has been constructed, and before another season arrives the remaining sections will be provided for.

There were certain sections along the line of the route where it became necessary to work night and day shifts, and since the organization was perfected each succeeding storm has been handled with increased alacrity and efficiency.

In the beginning the work was handled with the following organization and equipment, which has been augmented from time to time: 7 motor trucks and plows, 22 road machines, 20 drags, 105 teams, 3 tractors, and 200 men.

"Turning Waste Into Profit"

"Turning Waste Into Profit." This is the title of a 26-page booklet, size 8½ x 10¾ in., recently issued by the Prest-O-Lite Company, Inc., Toronto, dealing with the importance of conservation of steel and iron through oxy-acetylene welding and cutting. This booklet is profusely illustrated with halftone engravings showing many examples of Prest-O-Lite welding repairs, which have saved money for manufacturers, railroads, mines, machine shops, engineering and industrial plants in almost every line. We have been advised by the Prest-O-Lite Company that a copy of this booklet will be mailed free of charge to anyone interested.

Does Alkali Affect Concrete?

Results of Investigations to Determine to What Extent Failures of Concrete Tile and Culverts are Due to Alkaline Soils

THE disintegration of concrete when exposed to strongly alkaline soils and waters in arid regions of the West has been a subject of discussion by engineers and users of cement for the past ten or fifteen years. There are many concrete structures in these districts which do not appear to be affected by the salts, but there are some which show indications of being attacked.

There are many engineers who believe that well-fabricated concrete will not disintegrate when exposed to these alkali salts and that many cases of failure which have been reported have not been caused primarily by the alkali, but resultant from the use of poor aggregate, improper methods of fabrication, or other causes which resulted in a poor quality of concrete.

A laboratory investigation was started in 1908 by the technologic branch of the United States Geological Survey to determine the effect of alkali waters on cements and concretes. Briefly, these investigations showed that practically all cements are attacked by alkali waters upon exposure in the laboratory, and complete disintegration can be obtained under certain conditions. Similar investigations have been made by other laboratories with similar results.

Alkali Blamed for all Failures

The United States Bureau of Standards has made a field survey of concrete structures exposed to alkali waters in several of the Western states. There is a tendency for the cement user to attribute to alkali all failures occurring in these districts, if any alkali is visible in the surrounding soil. Therefore, such failures as occur in the eastern part of the country, due to poor materials or improper methods of fabrication, are often excused in the irrigated districts as failures due to alkali.

It is practically impossible to analyze some of the failures which have occurred and state definitely the part played by the alkali salts, as a result of which it was deemed desirable to make field tests in which concrete of known composition and fabrication would be exposed in some of the worst known alkali districts in the west.

It was decided that the investigation should be started by exposing various cement mixtures in the form of draintile, because of its economic importance. It was recognized that the results obtained with the tile tests would not predicate the behavior of mass concrete, for the normal exposure of the latter is quite dissimilar from that of draintile. Therefore, the investigation was expanded by the installation of generous-size blocks of concrete of known composition.

The size of the blocks and the conditions under which they were placed will make the results of the investigation applicable to normal concrete construction in the field under similar conditions.

The blocks were placed so that the lower ends extended into the ground water. This was done in order to observe the effect of the mechanical force exerted by frost action and by the crystallization of the alkali salts absorbed by capillarity into the pores of the concrete above the ground-water surface.

Tile Tests

The tile were made under contract at a commercial tile plant and under the supervision of a representative of the Bureau of Standards. Although it was anticipated that some of the tile of the leaner mixtures which are satisfactory in the humid regions would fail in these alkali soils, the program was arranged to include tile made from the leanest to the richest commercial mixtures.

The tile were installed in operating drains on eight projects in what were thought to be the most concentrated alkali soils available in the West and in districts where there was practically no alkali for comparison.

One set of tile of each type also was stored in the open exposed to the atmosphere for reference and test.

The programme requires the removal of at least two tile of each type at each project every year for test and inspection. Sufficient tile were made and installed to continue the investigation ten years or longer if necessary.

Effect of Alkali on Mass Concrete

The following investigation was outlined by the advisory committee for the purpose of determining the effect of alkali salts in the soil and ground water on concrete. Throughout the West many concrete structures are exposed to strongly alkaline soils and ground waters, and in some localities structures have failed or shown signs of disintegration, referred to previously. In order that actual field conditions might be duplicated, blocks of concrete 10 inches square and 2½ feet long were molded, under the supervision of a representative of the Bureau of Standards, and installed on projects in soils where concrete structures have apparently been affected by alkali. The blocks were placed vertically with about one foot embedded in the ground and a portion exposed to the atmosphere. One series of blocks was molded at a central point, where an excellent quality of aggregate was available, in order to secure a uniform and good quality of concrete. These blocks, called "A" specimens, were shipped to the various projects. Another set of blocks ("B" specimens) was molded at each project and after curing was set in place, while a third set, "C," was molded in place immediately exposed to alkali water. At each project the cement in use there was used, and the aggregates were of those at present available in commercial quantities near the site of construction on the projects.

Blocks were molded of the portland cement concrete of two different proportions, sand cement concrete and natural cement concrete. The test-tile was manufactured in sixteen different series varying in proportion, method of curing and mode of manufacture.

From the technologic paper, No. 95, the following conclusions in regard to the tests, are published:—

No definite conclusions can yet be drawn as to the ultimate resistance of concrete to the action of alkali in the soils and waters on the projects. However, the complete failures found at the Belle Fourche project, where local materials were used, together with the action which has commenced on the surfaces of many of the blocks on other projects, indicate that materials of good quality and proper workmanship are of greatest importance.

The surface action noted on blocks at several of the projects was not confined to those made of local materials, but was also apparent on some of the blocks made of selected aggregates ("A" series). Whether or not this surface action on the best-quality concrete blocks is progressive will be apparent after a longer period of exposure. Concrete which is to be placed in alkali soils should be made of selected and tested materials, so proportioned as to produce a dense concrete. As small an amount of mixing water should be used as will allow the mass to be properly placed. Unless these precautions are taken the resistance of the concrete to alkali action will be reduced.

Draintile

The following conclusions may be drawn for the use of cement draintile exposed to soils or waters containing alkali salts in quantities of 0.1 per cent. or more:

1. The use of cement tile in soils containing alkali salts in large quantities is experimental.
2. Porous tile due to the use of lean mixtures or relatively dry consistencies are subject to disintegration.
3. Some dense tile are under certain conditions subject to surface disintegration.
4. Disintegration is manifested by physical disruption caused by the expansion resulting from the crystallization of salts in the pores and by softening, resulting from chemical action of the solutions with the constituents of the cement.
5. While results obtained will not permit of a definite statement as to the relative effect of the various constituents of the salts, indications are that the greater the quantity of sulphate and magnesium present and the greater the total concentration of salts the greater will be the disintegrating effect.
6. Tile made by the process commonly used, which allows the removal of forms immediately after casting, are subject to disintegration where exposed to soils or waters containing one-tenth per cent. or more alkali salts similar in composition to those encountered in this investigation.
7. The hand-tamped tile of plastic consistency as made in this investigation are not equal in quality to machine-made tile of the same mixture, and they do not resist alkali action as well.
8. Steam-cured tile show no greater resistance to alkali action than tile which are cured by systematic sprinkling with water.
9. Tile made of sand cement have less resistance to alkali action than tile made of Portland cement of the same proportions.
10. The tar coating as used is not effective in preventing the absorption of alkali salts from the soil.
11. The cement-grout coating is not effective in preventing the absorption of alkali salts from the soil.
12. No advantage is found in introducing ferrous sulphate into the cement mixture.

If cement draintile are to be used in alkali soils or waters containing 0.1 per cent. or more of salts similar in composition to those encountered in this investigation, they should be made of good quality aggregate in proportions of not less than 1 part portland cement to 3 parts aggregate. The consistency should preferably be quaking, which has proved the most resistent of all mixtures used. This is wetter than that generally used in commercial plants and will probably require the retention of the tile in the molds for several hours, unless some means are found to hasten the hardening of the cement.

Tile Manufacturers Urged to Increase Output

Mr. W. H. Scott Tells Convention of Clay Products Men That Demand for Drain Tile Will Exceed Supply — By Supplementing Their Output Manufacturers Will be Aiding Movement for Greater Production

IN considering the clay tile situation in Ontario, at present we find that most of the tile is used in the western and south-western counties. Some tile is used in the central and eastern counties, while as yet very little is used in the northern counties. In the north-western counties, particularly the Rainy River District, the farmers are commencing to put in tile drains, but are using concrete tile. They are not able to obtain any clay tile in that district because of none being made.

Demand for Tile

In gathering information concerning this subject I wrote to several of the district representatives situated in the counties where most of the tile is used, and in answering, with the exception of one, they all agreed that the demand was going to be much greater than the supply of tile for the coming season. From a representative in a western county I received the following answer:

> "No clay tile in county. Making and buying tile held up because of labor shortage. Many local farmers anxious for development of industry."

From another county the answer was:

> "It is almost impossible to secure clay tile in this county."

From another:

> "There is quite a keen demand, but the supply has been limited."

From one of the central counties I received this answer:

> "In conversation with a local tile maker I am advised that he has 40,000 tile, sizes 3-inch and 4-inch on hand, and that he has sold one car load of these."

This answer, by the way, was from a representative of a county where little tiling is being done as yet. This was the only case reported where there was any tile on hand.

From a southern county I received this reply:

> "All the tile used in this county must be secured from outside sources." He goes on to say that: "We have one man alone who expects to use about 75,000 next summer on his farm, and we have several enquiries of other smaller jobs which will likely be done providing tile can be secured."

From one of the south-western counties I received this answer:

> "Owing to the scarcity of help this last year or two these yards have not been able to do all the work that was possible, neither have they been able to manufacture tile in quantities to meet the demand."

Another correspondent from the same district writes:

> "The problem in this county is to get the land surveyed, to get the tile and to have them placed. The shortage of labor is affecting both the manufacture of tile and the placing of them in the soil to a very marked degree."

Another correspondent, who, by the way, is situated in a county where most of our surveys are made, states:

> "We have in operation in this county about 35 ditching machines, and the tile produced in the same area is only sufficient to carry these machines 100 working days. There have been a large number of instances during the past year where tiling machines have been compelled to cease operation owing to lack of tile."

This will give you an indication of the circumstances in the south, central, western and south-western counties. I didn't enquire as to the situation in the eastern counties, but only a short time ago I received communications from two different correspondents regarding the prospects for the disposal of tile in that district as they were contemplating going into the manufacture of that product.

Supply Will be Insufficient

In consideration of this information which we have compiled we can readily see that the demand for drain tile for the coming season will be very great, and I have no doubt that in some districts will exceed the supply.

From the Statistical Review we find that in 1910 $318,000 worth of drain tile were manufactured, while in 1914 $277,000 worth were manufactured, being a decrease of $41,000 worth. In 1916, however, $275,000 worth were manufactured, so we see that during the last two or three years there has been about the same amount of tile manufactured each year. It is of interest to note here that the number of tile given in the last report exceeded the second last report by 2,000,000. There was, however, very little change in the total valuation, which goes to prove that a greater percentage of the smaller sizes of tile were manufactured than formerly. I have made several enquiries and find that in some districts there is no supply available, and that in some instances manufacturers have booked orders which will keep them working to full capacity until June of this coming season.

Quality is Sacrificed

We have found that owing to the large demand for clay tile, in some instances the quality of the product is not very good, due either to insufficient or faulty burning. Some tile are crooked, and in some lots a quantity of the tile are extremely well burned, while in the same lot we find soft tile, indicating that that lot has been burned in streaks, as the saying is, which I believe is due to the fact that the fires were replenished at intervals of one-half hour or more.

Some tile which I have seen had particles of lime in the wall. These particles of lime expanded when they came in contact with moisture, thus breaking the wall and reducing the strength of the tile in some instances, as we have ascertained by testing, as high as 50 per cent. We have found by work in testing tile which we have carried on at the Ontario Agricultural College that in a comparison between the white and the red tile, the red on an average is 19.8 per cent. stronger than the other.

We have found that the quality varies very much in different localities, and would suggest that the Canadian National Clay Products Association agree on some standard for the different sizes of tile and endeavor to have each tile manufacturer have his product equal to this standard. The Ontario Agricultural College would be only too glad to co-operate in this matter as we have a tile testing machine, and would be able to do the testing. If this matter were handled properly it would cause the manufacturers of a poor quality of tile to endeavor to overcome their difficulties and thereby save the waste of a large amount of both time and money, and the manufacturers would be able to supply the land owners with a first class product.

Fuel Difficulties

At present the fuel situation is quite serious, and I understand that in some districts where gas is being used, the gas companies have threatened to close down on the manufacturers. This will be a severe drawback to the manufacturers of tile, which at present is so badly needed by the land owners.

I note by the statistics compiled by the Bureau of Mines that the supply of crude petroleum is diminishing. In 1910 approximately 10,000,000 imperial gallons were produced in Ontario, while in 1915 the output had decreased to approximately 7,500,000 imperial gallons. One tile maker informed me that this crude petroleum would be prohibitive in price to use as a fuel. Others stated, however, that they could use it, and they thought they could use it profitably. However, this would not altogether solve the difficulty, because of the fact that there is so little fuel oil available in Ontario. It could, however, be used at present until the critical stage in the coal situation has passed.

Besides, in Canada we are told that there is a great quantity of peat, which, although it may not burn as satisfactorily as coal, will no doubt some day take the place of some of the coal as a fuel. In some districts the manufacturers are using wood for burning, and perhaps this fuel could be used temporarily by the tile makers in other districts. Of course, I realize that they would be compelled to change their furnaces, and wood would require more cars and additional labor in burning to get good results. It remains with them as to whether it would be profitable to do this or to use some other substitute.

Concrete Tile Manufacturers Taking up the Field

Some of the clay tile manufacturers have realized the present situation and are making efforts to increase their output, while others are passively leaving the matter to Providence, and when they cannot get fuel will cease manufacturing tile. Now, we know that the demand for tile is great, and that the land owners want drain tile. If they cannot secure clay tile, which they have been using to a great extent in the past, they are going, if possible, to purchase concrete tile. The concrete tile manufacturers will not be slow in taking advantage of this situation. The only fuel which they require is a small amount for steam, as they can obtain the rest of their power by using electricity, so that they have the advantage over clay tile manufacturers during the present situation. Unless the clay tile makers are able to supply the demand then their competitors will, and many of the concrete manufacturers are producing good tile, so those who are allowing their output to diminish while the demand is still great, may find it hard to again build up trade when there will be a sufficient supply of fuel.

Another matter which is causing trouble is the shortage of labor. One manufacturer whom I know has solved the difficulty to some extent by putting in additional machinery, and possibly others might be able to follow his example.

Plants Not Operating to Capacity

Many tile plants are not producing up to full capacity at present. In Ontario we have 146 power ditching machines. Considering an average season these machines should dig sufficient drains for approximately 115,000 tile each. When this is totalled, providing that each machine worked during the season, they would require approximately 16,800,000 tile, which is about 2,000,000 more than were manufactured last year. Besides these ditching machines we have in Ontario a few persons who still lay tile by hand, and many horse-drawn machines which no doubt would require an additional number of tile.

Regardless of the fact that both labor and capital were scarce there was as much ditching done last year as in any of the years previous, and the indications are that much will be done again during the coming season. The land owners look to the tile manufacturers for their supply of tile. If they are unable to procure that tile the work of tile drainage and reclamation of the land will suffer, and just so much as that suffers there will be less grain and other agricultural products produced, which are so necessary at the present time.

Clayworker Dependent on Geologist for Advice on Plant Location

By N. B. Davis

IN the past ten or more years the application of scientific principles to the management of industrial enterprises has become a necessity, and the old "rule-of-thumb" methods are passing away. Our position in this war has impressed on us the need for technical control in all phases of our industries, and the present seems the time to call the attention of the clay industry to the part of the economic geologist.

With the general industrial advance the clay industry has not progressed as it should, considering the importance of the industry. Conditions in the United States were bad enough in 1916 to warrant the Director of the Bureau of Standards issuing a warning, having in view trade competition after the war.

The Canadian industry is in the same position as that of the United States, only on a smaller scale. Our range of products is not as large as that of the United States, but we have to use a wide range of raw materials.

Position of the Ceramic Engineer

A few years ago the ceramic engineer was practically unknown and the industry was wholly in the hands of the practical clayworker. With the coming of the ceramic engineer technical control was introduced and less was left to chance. At first the whole field was covered, from the location of the raw material to the marketing of the finished product, but so many advances have been made in the mechanical operations that the engineer has been forced to confine himself to that part of the business. The same development has taken place in the mining engineering profession, and coincident with this specialization the economic geologist or geological engineer has come into being to take charge of the locating of the raw materials.

You are perhaps more or less familiar with the term "geologist," and know that he is primarily a student of the history of the materials of the earth's surface, or, in other words, a student of the raw materials of the mineral industries. As a student of the materials of the earth's surface, he is a pure scientist, but as a student of the raw materials of the mineral industries he is an applied scientist of the first order.

The popular idea of a geologist makes him a gatherer of fossils and mineral specimens, or, as I once heard him described, as "a musty old college professor going around collecting fossils." An examination of his record in connection with the mineral industries would show that he has never been musty. It is true that in the past he was greatly interested in pure science, but in the end all scientific knowledge has a practical bearing, and what may seem abstract to-day may be applied to-morrow.

In the petroleum industry of the last few years the geologist has received considerable prominence. Ten years ago he was hardly recognized, but to-day an oil company without the services of a competent geologist is groping in the dark.

The Geologist's Relation to the Clay Industry

Turning to the clay industry we find that the geologist has been recognized to but a limited extent, and the locating of the raw materials is still largely left to chance. In Canada there are plants east and west, most of them large installations, that are seriously handicapped because of being poorly located with regards to the best raw material available. Had the services of a competent geologist been employed to locate suitable raw material before the plant was built many thousands of dollars and infinite worry would have been saved in the subsequent operations.

For years the Geological Survey of Canada has been studying and mapping the geology of the country and the distribution of the various formations are known and recorded. Within the last ten years, using the geology as a basis, a fairly detailed survey has been made of the possibilities of the clay or shale bearing formations, and most of the information is published in the reports of the Department of Mines. With this information to work on and to be interpreted as economic geology there should be no mistakes in the future locating of clayworking plants.

Need of Geologist's Services

As concrete evidence of the need of the services of the economic geologist I might briefly point to several mistaken locations. One plant was built to use a shale for making paving brick, but after running for a short time it was found that the material would not do. A few miles away, and favorably located, there is a good paving brick material. Had the geology been studied and the available shales tested there would not have been the mistake in location.

Another plant located its buildings where its shale pit should have been, due to a lack of advice regarding the geology of the property.

A plant in the west was built to use a material that later proved so defective that it had to be disregarded completely, and new material looked for. In looking for new material the usual hit and miss methods were employed. Had a geologist been employed to survey the field of possibilities there would have been a great saving in money, time and temper.

These are but a few instances of the difficulties Canadian plants have got into through a lack of appreciation of the value of the economic geologist.

The Commission of Conservation has reprinted from its Ninth Annual Report, a pamphlet entitled, "Peat as a Source of Fuel," by Eugene Haanel, director, Mines Branch, Ottawa.

Granite Block Pavements

Their Present Status—Modern Practice in Construction — Improvements Have Made Granite an Excellent Surface

FROM the time when pavements of rectangular granite blocks were first employed in 1876, there has been steady development and improvement, with consistent attempts to standardize materials and methods. In size and quality of blocks, nature of foundation and joints, and manner of laying, modern practice in regard to granite block pavements has been pretty well delineated and standardized in such a way as to insure an excellent type of roadway surface. The present status of such pavements is outlined in the following article which was prepared by Clarence D. Pollock, consulting engineer, New York, for presentation to the American Association for the Advancement of Science, and which traces their development and describes modern practice in regard to their construction:—

The early specifications called for blocks of about the following dimensions:—Length 8 to 12 inches, width 3½ to 4½ inches, and depth of 7 to 8 inches. These were paved upon a sand bed spread upon the earth subgrade and the joints were filled with sand.

The next step was to use a concrete foundation under the sand cushion and a joint filler of gravel poured with bituminous material. The maximum width of joints was usually three-quarters of an inch. The pavement was rammed and back rammed, after which an attempt was made to scratch out the gravel from the top portion of the joints, and then the bituminous material was poured in while hot. This was unsatisfactory as the filler simply matted on the top of the gravel unless the conditions were almost ideal. The next change was to put a small amount of gravel in the joints, and then pour this part of the joint, after which dry and hot gravel was added and the joints were given a second pouring. This was an improvement, but as the joints were wide, the blocks chipped on the edges under traffic, and the pavement became rough and uncomfortable to ride on.

These blocks were large, having a depth of from 7 to 8 inches and were often 13 inches and even as much as 14 and 15 inches in length. With such deep blocks it was not practical to cut them so that they would lie with close joints.

Requirements in General Use

Finally, some seven or eight years ago, at a conference between municipal paving engineers and the granite quarrymen, it was agreed to use a smaller and better cut block. This was the beginning of our modern granite block pavement. The present standard block has a width of from 3½ to 4½ inches, a length of 8 inches to 12 inches, and a depth of 4¾ inches to 5¼ inches.

Further requirements are that "the paving blocks shall be of medium-grained granite, showing an even distribution of constituent materials, of uniform quality, structure and texture, without seams, scales or disintegration, free from an excess of mica or feldspar. The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding one-half inch in width at the top, and for one inch downward therefrom, and not exceeding one inch in width at any other part of the joint. The top surface of the block shall be so cut that there will be no depressions measuring more than three-eighths of an inch from a straight edge laid in any direction on the top and parallel to the general surface thereof."

Expense of Smaller Blocks Not Justified

The above requirements are in the specifications of the American Society of Municipal Improvements, and are now in very general use.

Of course, there are numerous exceptions to these standard blocks. A few cities specify a block with a length of six to ten inches with a top surface or head cut so that there will be no depressions measuring more than one-quarter of an inch and to lay to a joint not exceeding three-eighths of an inch. Such a specification may produce a pavement with possibly ten per cent. of the joints better than with the standard specifications, but as the area of the head of the block is smaller and consequently more blocks are required to the square yard, it adds considerable to the cost of the pavement, and the writer is of the opinion that this extra expense is not warranted except in rare instances. When standard blocks are well cut and properly paved under the specifications that the joints shall not exceed one-half of an inch in width, something like seventy-five per cent. of the joints will comply with the more rigid specifications, and it would seem unnecessary to spend an additional forty or fifty cents per square yard to have possibly another ten per cent. of the joints a little closer. Such a requirement is practically as rigid as that for cut stone joints in building construction. It is not a practical proposition to split out paving blocks so that a three-eighths of an inch joint can be rigidly complied with. If a cement grout filler is used, such a joint is not necessary, and it is very questionable if it is ever necessary with even a bituminous filler. It certainly is not desirable to specify something which it is not practicable to obtain.

Shallow Blocks Sometimes Necessary

Other variations from the standard are so-called four-inch blocks, Durax blocks, and the like. It is sometimes necessary, because of freight charges, etc., to use shallow blocks, or else use a pavement which is less durable than granite blocks. This condition is more likely to prevail on road work and in inland cities where there is a rail haul.

Then there is another condition which requires a shallow block, and that is where the traffic conditions have changed so much that it is necessary to use granite to replace a lighter material, and yet it is desired to utilize the old concrete foundation. For such a condition a resurfacing block is made which has a depth of three and one-half to four inches. It is preferable to lay such a block upon a cement mortar cushion, especially if the traffic is heavy.

The standard block when properly cut and laid is the most suitable for general conditions. This pavement is laid in various ways. In cities and localities where it is possible to block off traffic for a sufficient time to permit the use of a cement grout filler, it is usually laid with such a filler, and if the traffic is heavy enough to warrant the expense, it is often laid on a cement mortar cushion mixed in the proportion of one part of cement to three or often four parts of sand. This makes a very solid and durable pavement when properly done. The blocks should be sorted and laid in courses so that blocks as nearly as possible of the same width are in a course, and the blocks should be paved with close end or longitudinal joints, the courses running transversely from curb to curb. The transverse joints should be as close as possible and yet keep straight courses. The longitudinal joints should be broken by a lap of at least three inches.

Thorough Ramming and Bedding Essential

The pavement should be thoroughly rammed and all poorly bedded blocks raised and back rammed until the blocks are all well and evenly bedded and the surface of the pavement is true and even to the grade and crown of the street. It is advisable to use no sand or gravel in the joints. Proper ramming will cause the blocks to sink into the cushion so that a little ridge of the cushion will separate the blocks and be sufficient to hold them until the filler is poured, provided wheeling and other traffic is not permitted over the surface.

Now the pavement is ready for the filler. If it is to be a cement grout filler, it should be mixed in the proportion of one part of portland cement to one part of fine sand, preferably an even grained sand, and when possible to obtain it, without excessive cost, one which will pass a 20 mesh sieve. The finer and more even the sand particles, the better they will remain in suspension and make a uniform filler. A machine mixer should be used in order to secure a uniform product and the grout should be delivered directly upon the pavement by means of a chute or spout. The grout should then be broomed into the joints thoroughly until they stand full and flush with the surface of the blocks, but a surplus should not be left over the surface. The wear should come upon the granite. The traffic will then wear down any small irregularities in the heads of the blocks.

Bituminous Filler

When a bituminous filler is used the best practice is to add a fine hot sand and mix it before pouring the joints. A straight coal tar pitch is too susceptible to temperature changes to be used in this climate, but a mixture of one part of asphalt with five parts of coal tar pitch gives good results, as does also an asphalt filler. With either of these there should be added not to exceed fifty per cent. by volume of fine sand similar to that used in a cement grout filler. The amount of sand added should be at least 35 per cent. The sand should be mixed into the hot bituminous material and then drawn off into wheelbarrows or the like and dumped at once upon the pavement. It can then be worked into the joints by means of hoes or the like. When the joints are thoroughly filled so that they stand up flush with the surface of the blocks, then a small amount of sand should be spread over the surface. This will prevent traffic from sticking and will help to harden the surface of the joint filler.

Brooklyn, N. Y., uses a mixture of coal tar pitch, 100 parts; refined residual asphalt, 20 parts; to which, after thorough mixing, is added not to exceed one part of sand to one part of this bituminous mixture. The sand is fine, passing a 20-mesh sieve, and is stirred in usually by a mechanical mixer.

In the Borough of Manhattan one part of hot asphalt cement is mixed with not to exceed one part of sand, the latter to pass a 10-mesh sieve. The mixture is made in a concrete carrier or pushcart of about seven cubic feet capacity. The mixing is done with a rake or a perforated hoe. Both here and in Brooklyn the hot bituminous mixture is dumped directly upon the pavement and is pushed into the joints by means of hose or squeegees. These forms of bituminous fillers give the best results for this class of filler.

Bituminous fillers are most suitable for use when the traffic conditions are such that it is not practical to block off the street a sufficient time to permit the proper setting of a cement grout filler.

Cushion Course of Sand or Dry Mortar

The cushion course on top of the concrete is usually sand, and it should not be greater in depth than an average of one inch. This is sufficient with a specification allowing only a maximum variation of one-half inch in the depth of the blocks. Of course, the surface of the concrete should be smooth and it should conform to the crown of the finished pavement.

In some localities a dry mortar cushion of one part cement to four parts of sand has been used with success, especially where the joint filler was cement grout. This makes a very rigid pavement, and where the traffic warrants the additional expenditure of about fifteen cents per square yard it is probably advisable. The mortar cushion has been used also with a bituminous filler, but this seems to the writer to be a useless expense as the traffic is allowed on the pavement before the cushion can obtain a proper set and an examination of many openings has failed to show him a case of a bond between the bottom of the block and the mortar cushion. The claim is made that this cushion does not wash if any water finds its way through the joints of the pavement. If the joint filler is properly placed in the joints there should be no trouble from this source, even with a sand cushion. With a cement grout filler the blocks are held rigidly and the cushion obtains a proper set as the traffic is blocked off in order to permit the grout to set and the cushion has the same opportunity.

Modern Granite Pavements are Smooth

Even with the great strides which have been made in granite block pavements in the past half a dozen years, there are still a great many people in our cities who still picture the old style rough open jointed granite pavements when they hear granite mentioned in connection with pavements. As a matter of fact these same people will ride over the modern smooth surface granite block pavements laid with cement grouted joints or with the latest form of bituminous joints and not recognize that it is a granite block pavement, and consequently fail to give it the credit which is its due.

The modern granite blocks when properly laid make a pavement which is as nearly permanent as it is possible to lay, and which is smooth and yet not slippery. While it is not wholly noiseless under metal tire traffic, yet because of its smoothness and the fact that the percentage of this kind of traffic is getting smaller and smaller each year, it is rapidly becoming a noiseless pavement.

The great improvement in the surface and the joints of this pavement in recent years has been due wholly to the co-operation between the engineers and the granite quarrymen. They have worked together in the endeavor to produce as good a block as it is practicable to make on a commercial scale, and then having these blocks paved better and closer than formerly and then really filling the joints with more permanent kinds of joint fillers. Neither the engineers nor the quarrymen could have accomplished this alone, but both working together with the same goal in mind resulted in great improvements in granite block pavements in a comparatively short time.

New Wall Construction Claimed to Prevent Displacement of Reinforcement

ONE would think that the construction of walls does not give much scope for ingenuity, but that is far from being the case. It was stated recently that whatever improvements have been effected in other components of a building, walls have remained much as they were in the times of those great builders, the Romans, and dependence upon thickness is necessary to secure warmth in view of the porosity of bricks, and to secure strength, also.

Upon the introduction of reinforced concrete it was thought that all difficulties were solved, but a tendency was discovered for the reinforcing bars to become displaced from their proper positions, and the use of such construction became limited to certain functions.

Another attempt to overcome drawbacks was made by building walls of concrete blocks, but the result was not fully satisfactory, as the "key" to the rendering required to make the wall weather-proof was rather uncertain.

For ordinary dwellings, at any rate, the old-style brick or stone wall, with all its faults, held its position; but the demands of war and dearth and cost of certain materials directed attention once more to the use of new methods, and economical ones.

The latest type of wall to be submitted to the investigation of builders is one which consists of a core of clinker or concrete blocks, or hollow blocks, to which, on the outer surface, reinforcing bars are attached by means of "stirrups." The outer surface is then rendered with cement mortar, and, as an additional precaution, the wall may be treated with a waterproofing compound, though experience has proved, it is said, that with good sand, well mixed with the cement, a waterproofing compound is unnecessary.

Several distinct claims are made for this wall construction, which is patented. It is claimed that displacement of the reinforcing rods cannot occur, and that they form a perfect "key" on which to affix the rendering, thus preventing it from cracking. Another claim is that the utmost strength is provided by the arrangement, the rods being in tension, and the core in compression as theoretically essential. The carrying capacity is said to be very great, a 4-inch wall of the type being equal to a 14-inch brick wall, and a 6-inch one equal to a brick one of 18 inches. A considerable saving in space would be thus secured.

Other points urged are that no centering is required, and that the wall is a non-conductor of heat.

In New Brunswick there are now six shipyards in operation. At St. John, Grant & Horne have completed the frame of a 3,000 ton wooden steamer of the Imperial Munitions Board type, and have the material ready for another steamer of the same dimensions. The Marine Construction Co., Ltd., have a schooner of 900 tons well advanced in their Strait Shore yard. The St. John Shipbuilding Company state that they are getting out timber this winter for six schooners and that they will take orders for vessels from 500 to 1,200 tons register.

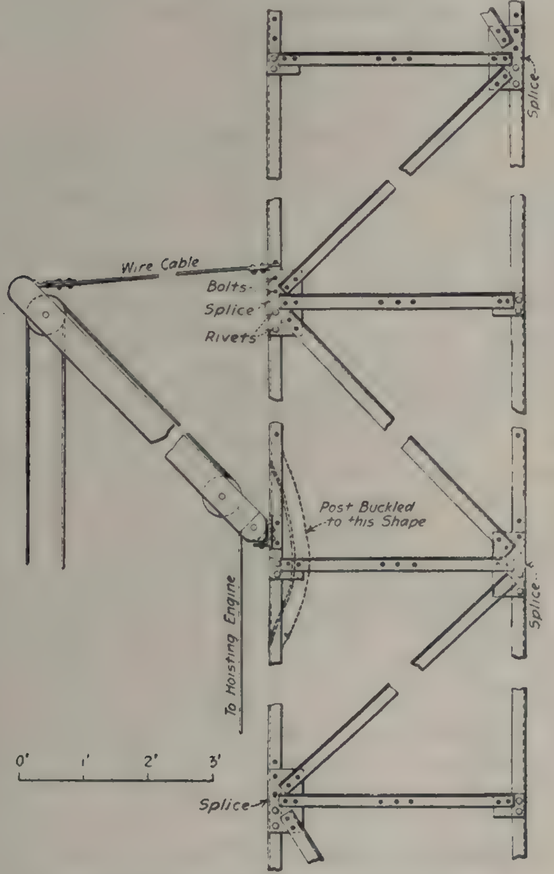
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Steel Tower Was Not Taken Down to Replace Buckled Corner Post

WHILE lumber was being hoisted to one of the upper floors of the Industrial Arts Building of the new East Side High School in Cincinnati, the load began to spin, and the hoisting lines became crossed. A heavy strain was put on the boom, which buckled the corner post at which the boom was seated, as shown in the accompanying sketch. Although there were 132 feet of steel tower above the buckled section, it was taken out and replaced without taking down the tower. The following description of the repair is by J. T. Sullivan, in Engineering News-Record.

The bearing timbers were inserted underneath the second horizontal member above the boom seat and on top of the first horizontal member below it. A timber and a shoring jack were inserted to restore the tower to plumb and take the weight off the damaged section. The second panel part above the boom seat had to be used as the upper support, since the gusset at the first panel point was riveted to the damaged section of the angle post and had to be removed with it.



Quick repair made to buckled post of steel tower.

After slight strain had been taken on the jack the bolts in the damaged section were easily loosened and the section was removed. The jack was then tightened and the corner raised to its original level, after which the new section was inserted and bolted.

The entire repair had been completed within 1½ hours after the accident. In the opinion of the writer the small amount of trouble and delay occasioned was due to the fact that the accident occurred with a steel tower. Had it happened with a wood tower the corner post might have snapped off and caused the collapse of the entire upper part of the structure.

Strips Embedded in Concrete Hold Floor Sleepers Firmly Without Shores

WHERE wood upper floors are laid over concrete slabs or arches they are generally nailed to sleepers embedded in cinder concrete filling above the surface of the stone concrete. Considerable difficulty is likely to be encountered in placing the sleepers in the exact position and holding them there until the cinder concrete around them sets and locks them to position. The sleepers are generally held down by shores and wedges reacting against the floor above.

The sleepers, being loose, cannot easily be maintained in exact horizontal positions in the wet cinder concrete and the vertical shores holding them down form inconvenient obstructions and are likely to be displaced.

A simple and convenient way of fixing the sleepers is described in "Contracting," and has been satisfactorily used by the H. B. Best Company, New York, who place on top of the stone concrete floor arch or slab wooden strips 4 ft. apart on centers that are transverse to the floor beams and are carefully embedded in the stone concrete so that their upper surfaces are flush with it. These strips, 1 inch thick, are 1¼ inch wide on the bottom and ¾ inch wide on top, so that the bevelled edges lock them firmly into the concrete and provide sufficient anchorage.

After the concrete is set the sleepers are laid on its surface transverse to the embedded pieces to which they are nailed, securing them firmly in position and holding them accurately until the cinder concrete is filled in around them and anchors them yet more strongly when it sets.

This method very easily provides for accuracy of horizontal and vertical position, eliminates the necessity for careful handling, and leaves the floor space entirely unobstructed by the vertical shores formerly used to hold down the sleepers.

Publication Received

The Village Beautiful—descriptive of the industrial townsites developed by the Connecticut Mills Company, Danielson, Conn.

Montreal Builders' Exchange Has Scheme For Governing Montreal

THE Montreal Builders' Exchange has taken a hand in devising plans for the better government of Montreal. The Legislative Committee has formulated a scheme of its own, which has been approved by the members. The report is signed by Mr. W. E. Ramsay, convenor of the Legislative Committee; Mr. J. P. Anglin, president of the Exchange; and Mr. David K. Trotter, secretary. The plan briefly is a mayor elected by the proprietors at large, with 25 aldermen, five of whom are to be elected by the real estate proprietors as an executive committee of finance, the remaining 20 aldermen to be chosen by four wards. The twenty aldermen will form four consultative committees—legislation, public works, public safety, and health. The recall for mayor and aldermen is a feature of the plan. The committee gives special emphasis to the proper methods for preparing plans and specifications, inviting, receiving and accepting tenders, the official granting of contracts and the methods of seeing that the work is carried out.

Replacing Openings in Concrete Pavements

WHEN it becomes necessary to make openings in concrete pavements for any purpose, such openings, according to the Concrete Highway Magazine, can be readily made and replaced so that when properly finished it is difficult even to find the spot repaired. One of the essentials for work of this kind is to cause the least obstruction possible to traffic.

The time necessary to protect the repaired spot may be very materially lessened by proper manipulation of the concrete in making the repair. The edges of the opening should be trimmed so as to present a practically vertical but rough edge for at least three inches from the surface. The subgrade should be thoroughly tamped and consolidated. The sides of the concrete are then to be cleaned and thoroughly wetted. If it is a dry season the subgrade should be dampened.

The concrete should be made of a rich mixture, in the proportion of 1:1½:2½. If practicable, sand and aggregate similar to that of which the pavement is made should be used, in order to have the repaired portion of similar appearance as the rest of the pavement. No more water should be used than will give a plastic, quaky mixture, and the mixing shall be done for at least two minutes. The concrete is to be thoroughly rammed in place and sufficient concrete used to little more than fill the hole so that there will be about one-half inch excess. The concrete is then to be rolled and the rolling continued until the excess concrete is practically squeezed to one side and all excess water taken out. The more thorough the rolling the sooner can the repaired spot be opened to traffic. The rolling may be continued at intervals of five or ten minutes for upwards of two to three hours, as long as the concrete remains in a plastic condition. It will be found that concrete manipulated in this manner will assume a gelatinous consistency and the repair thus made will develop a strength in four or five days equal to that of ordinary concrete much older.

A repair made in this way, covered with a layer of damp earth, and so protected for four days, may be opened to traffic on the sixth day.

If traffic cannot be diverted so as to pass on either side of the repaired place, while hardening, it may be protected with a plate of steel or boards over which is thrown sufficient gravel which will cause little obstruction to traffic and hold the covering in place.

Slippery Paving Bricks

A STUDY of paving bricks shows that their greatest disadvantage is the smoothness and slipperiness which they develop as the result of wear. This is so serious as to preclude their use in many places where they would otherwise be extremely satisfactory.

Various methods have been tried in order to overcome this smoothness, such as grooving the upper surface of the bricks, imprinting a pattern in low relief, and so on, but such devices are clearly only palliative, and are often accompanied by serious drawbacks.

What is required is a hard and impervious material which will remain rough under abrasion instead of being polished. The United Mosaic Works of Friedland-Sinzig claim that by the use of a material the particles of which are hollow, they have been able to produce an ideal paving material, and one which is quite impervious to water, yet never becomes quite smooth. The nature of the material is not disclosed; it is presumably some form of kieselguhr, which consists of minute hollow particles. On mixing a suitable kieselguhr with an appropriate bond and making bricks from the mixture and burning to a sufficient high temperature, it should be possible to produce an impervious brick which would not wear smooth, but whether such a brick would be sufficiently hard and durable remains to be proved.

Standardizing Roofing Stock

In the report of the Felt Division submitted to the annual meeting of the Pulp and Paper Association held in Montreal, Mr. G. M. Greaves referred to the efforts made to obtain a standard classification of roofing stock. He stated that from the favorable answers received it looked as if the leading dealers and packers will adopt this standard classification. He added that considerable quantities of Canadian roofing felt have been exported, also large quantities of prepared roofing manufactured from Canadian roofing felt have been shipped by the various Canadian prepared roofing manufacturers to our allies in Europe.

Ottawa C. S. C. E.

Mr. H. H. Vaughan, president of the Canadian Society of Civil Engineers, addressed the Ottawa branch of the Society on February 7 on the subject, "Problems Confronting the Society." This was the first luncheon of the branch for 1918 and was held in the Chateau Laurier. Mr. Vaughan discussed such matters as change of name, the broadening of the scope of the Society and the effect of the new by-laws which give branches greater control over their own affairs.

Pending Legal Action, C. S. C. E. Maintains Name

The Council of the Canadian Society of Civil Engineers has decided that the revised by-laws take effect from January 23. A committee has been appointed to take the necessary legal steps to bring into effect the change of name to the Engineering Institute of Canada. Until this is done, the Society will continue under its former name.

Electricity for Clay-Working Plants

Special Power Requirements of Clay Products Factories and Application of Motors to Meet These—Paper before C.N.C.P.A.

By Kenneth C. Berney*

Some years ago it was the general custom to drive the machinery in clay-working plants by means of steam engines. Some of the smaller plants were operated by horse-power. Now a large number of the plants, both large and small, in localities where electricity is available, are operated by electric motors.

In some plants electrical operation begins with the digging of the clay, and is used in every operation, including hauling the shale, dumping the cars, grinding, conveying, mixing, forming the product, and conveying the finished product.

We will now discuss briefly the advantages of electric motor drive over steam engine or drive from a central plant.

In contemplation of the layout of a brick, tile, or pottery plant the first point of consideration is the location. Railroad facilities, water, coal, and location of raw material are very important factors. The use of electricity, especially when supplied by central stations, simplifies the problem since the water and coal questions become of secondary importance.

Flexibility of Electric Drive

With electric drive the various departments of the plant can be located and arranged to the best advantage for operating without the limitation of arrangements imposed by central engine drive with the accompanying belt connections to the various departments.

With central steam engine drive there must be used long line shafts and belts. If it is desired to operate only one machine or department in the plant, all of this shafting and belting must be run, which means a large friction load. In such cases this power lost in friction may equal or exceed that used in doing useful work. Not only is the cost of such waste power a big item, but the wear on the belts, shafts, and bearings is considerable. Where there is fine clay dust in the air this wear is very great. The dust collects on the belts, pulleys, and works into the hanger bearings, causing belt slippage, which means decreased output, the belts must be run very tight. With individual motor drive made economically possible by using electric motors, energy is required only when useful work is being done. The control of any one machine is conveniently at the hand of the operator, and the machine can be started and stopped at will. There is no cost for power after the machine is shut down, as would occur were long lines of belting and shafting used.

In plants where there is excessive clay dust in the air electric motors can be direct connected or geared to the driven machines, doing away with belt trouble entirely.

Greater Assurance of Continuous Operation

When the various machines or departments are operated by means of individual motors there is a greater assurance of continuous operation as compared with central engine drive, in which case engine trouble means the shut-down of the whole plant. Motors maintain a practically constant speed throughout their operating range, which results in increased production over the plant driven by a single steam engine where the speed varies not only with the boiler pressure but also with the variation in load.

Electric motors can be placed wherever convenient on the ceiling, on a side wall, on the floor, or right on the machine to be driven, and the machines can be located to best serve the logical sequence of operations. The flexibility of a motor system is also of the greatest advantage, since frequent changes in the positions of the machines and additions to the equipment are often necessary. When motors are used they can be shifted with ease. All that is necessary is to run feeders to the new location. New machines can be added to any part of the plant without fear of overloading the engine, as in the case of central engine drive.

Due to the fact that motors can be applied at the closest position to the driven machines, belts, gears, etc., are reduced to a minimum. The absence of many shafts, belts, and pulleys means that the plant will be lighter and cleaner, allowing more and better work to be done.

Fuses or circuit-breakers are installed in the motor circuit as a protection against heavy overloads such as might occur if a machine became clogged with clay. In such a case the current is cut off from the motor, and it stops preventing any damage to it or the driven machine. The possibility of a shut-down due to a machine breaking is thus reduced to a minimum.

Clay-working machines may be driven by either direct current or alternating current motors. If a plant generates its own power or is right near the central station, direct current may be used for its operation. Due to the fact that direct current cannot be transmitted long distances economically and alternating current can, practically the only current supplied to-day by central stations to power users is alternating current.

Two Main Types of Motors

So we will deal with the alternating current motor as it is used almost exclusively for industrial drive. There are two main types of polyphase alternating current motors used for manufacturing purposes—the synchronous motor and the induction motor. The synchronous motor is often used to drive machines requiring, say, 200 horse-power or more where the starting conditions are light, where the starting current is not objectionable, and where only one speed of operation is desired. If overloaded more than about 50 per cent., or the voltage at the motor terminals allowed to drop more than about 10 per cent., a synchronous motor will stop.

The induction motor is used to drive such machines as required in clay-working plants, so we can confine our remarks to this type of motor.

The induction motor consists essentially of a stationary part, at either end of which is a bracket supporting a bearing. The shaft which rotates in these bearings has mounted on it a rotating member. The clearance between the rotating and stationary parts is small, being less than 1/16 in. in a 50 h.p. motor. There is no electrical connection between rotating and stationary parts, and there are few parts to get out of repair. The induction motor is the most rugged type of electric motor made.

There are two main types of polyphase induction motors —that having a squirrel cage rotor and that having a wound rotor. They are commonly called the squirrel cage motor and the wound rotor or slip-ring motor. The rotor, as the name implies, is the revolving part. The stator, or stationary part, is practically the same in both types of motor.

Squirrel-Cage Motor Generally Preferable

The squirrel cage rotor derives its name from the fact that its winding resembles in appearance the rotating wheel found in a squirrel's cage. The winding consists of two heavy copper or alloy rings, which are held in place by bars, usually made of copper, which span the space between the rings at regular intervals. The ends of these bars may be riveted, bolted, or welded to the two rings. The rotor of a wound rotor motor has on it a winding similar to the stationary part, consisting of many turns of insulated copper wire. The leads from the different phases of the winding are brought out to three collector rings, on which slide the carbon brushes which carry the rotor current to the external resistance which is used with this type of motor. The collector rings are often called slip rings, from which comes the name slip-ring motor. The squirrel cage rotor is more rugged than the wound rotor, and there are less parts to get out of repair. The squirrel cage rotor is practically indestructible on motors of the latest type where the rotor bars are welded to the two rings, which are called resistance rings. A squirrel cage motor is considerably cheaper to buy than a wound rotor motor. So, everything considered, the squirrel cage motor should be chosen rather than the wound rotor or slip ring motor, except in a few applications where the latter is particularly suitable.

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*Of Canadian Westinghouse Co., Hamilton, Ont.

Where it is desired to have a motor operate at a number of different speeds the wound rotor motor is used. It is very often used where the torque required to start a load is very great. This is particularly true where the power plant supplying the current is of limited capacity, as less current will be drawn from the line at start than were a squirrel cage motor used. The wound rotor motor in a clay plant is sometimes used to drive the dry pans, pug mills, and auger machines. When squirrel cage motors are used with these machines motors with large starting torque should be applied, unless there is a clutch between the motors and the machines. Wound rotor motors should not be used where there is stone dust in the air unless the collector rings are closed in, as such dust, getting between the brushes and rings, rapidly wears the collector rings. Squirrel cage motors can be supplied suitable for driving all the machines used in clay-working plants.

Characteristics of Induction Motors

A few of the characteristics of an induction motor which may be of interest are as follows:

1. It will carry a load for short periods of two to two and a half times full load without injuring the motor and without the motor stopping.
2. The speed of the motor will be practically constant from approximately 50 per cent. load to 50 per cent. overload.
3. The motor will start a load where the starting torque required is considerably greater than the running torque. The motor can be designed with a starting torque up to two and a half times the running torque where desired for heavy starting service.
4. The current taken by the motor when starting will be approximately two to five times that required when running. It depends on the load to be started.
5. If the voltage at the motor terminals drops below normal the starting torque will decrease as the square of the terminal voltage divided by the normal voltage.

In applying electric motors to clay-working machinery the following severe conditions must be kept in mind:

1. Severe starting requirements, due to the inertia of the driven machinery and to material in the machinery hardening when at rest.
2. Severe overloads, due to irregular feed of material.
3. Dusty atmosphere about plants and presence of dampness, causing collected dust on the motors to become cemented to the windings and interfering with ventilation.
4. The use of gears of large pitch and high pitch line speeds, resulting in severe vibrations.

Good service is obtained with these conditions only when careful consideration is given to the application to each individual machine. The motors in clay plants should have generous starting and running characteristics, the bearings made dust-proof, and the windings impregnated to withstand moisture. The motors should be carefully aligned with the driven machines. The feeders to the motors should be of ample size to carry the current, bearing in mind that motors which drive machines hard to start will draw much heavier currents than those driving machines easy to start. If the feeders are too small the terminal voltage will be lowered, with consequent decrease in starting torque.

To provide for the severe starting and running conditions there has been a tendency to select motors larger than necessary. The result of the low load factor caused thereby is low power factor and low efficiency of the individual motors. On account of low efficiency the cost of electric power will be greater. This cost will still be increased if there is a penalty for low power factor. The best plan is to consult the manufacturer who can supply a motor just large enough to do the required work, and with large starting torque where such is required. In case of machines hard to start, a standard squirrel motor can be used in combination with a friction cluth and the motor started without load. Friction clutches, however, are subject to wear, and should be avoided wherever possible.

Consideration must be given as to whether group or individual drive of machinery would be better. For plants with storage facilities between the various departments and the machinery scattered individual drive will usually be better, while for plants with all machinery inter-dependent and grouped group drive will be better.

The following are usual drives employed for the more common machinery found in clay plants:

1. The conveyor from the storage bin is usually belted from the motor driving the crusher or dry pan.
2. Crushers are usually belted to the motors. Motors with good starting and pull-out torques are required with all kinds of crushing machinery.
3. Dry pans are usually driven by motors geared to the dry pan shafts. The vibrations of these machines are severe, and the motor shafts should be supported by outboard bearings. An improved arrangement is to have flexible couplings between the gearing and the motors, as this prevents the transmission of vibrations to the motors to a large extent.
4. The pug mill and auger machines may be driven by motors, either belted or geared to them. Because of the large pitch of the gears of these machines considerable vibration results, and flexible couplings should be used if the motors are geared. These machines are sometimes stopped full of material, which hardens if the shut-down is of an appreciable length, and, if clutches are not provided, the starting requirements of the motors are severe. For such installations wound rotor motors are advisable.
5. The cutters, represses, elevators, and conveyors between the various machines require little power, and may be driven from the motors driving the machines upon whose operation they are dependent, or individually by small motors.

We will now briefly outline the motor drive in various kinds of modern clay-working plants. First, we will touch on the most common of all—the brick plant.

Brick Plants

There are three common forms of brick plants, depending on what kind of machinery is used to form the brick. There are the "stiff mud," the "soft mud," and the "dry mud" machines.

In case the raw material used is shale or rock, crushers or dry pans are usually used, while for soft and stiff mud, refining rolls or various kinds of pulverizers are used.

First, we will take a plant with a capacity of approximately 60,000 building bricks an eight-hour day. Both common and face brick are made from hard shale. This plant is the type where "stiff mud" machines are used, forcing the clay through dyes by an auger machine into a continuous bar, which is cut into bricks by parallel wires or by au automatic cutter. In this plant the air is drawn from the kilns containing the burned brick during the cooling period and passed through drying tunnels containing the green brick, drying the same. When it is desired to move the dried brick the hot air is shut off and the air in the tunnels is cooled by an exhaust fan. Squirrel-cage motors, two-phase, 220 volts, 60 cycle, are employed for the entire operation of the plant. The total motor capacity is 215 h.p. and the maximum demand is 130 h.p.:—

One 40 h.p.,; 850 r.p.m. Drive—Geared to and belted. Application—9 ft. dry pan. From extension shaft of dry pan to 40 ft. bucket conveyor.

One 40 h.p.; 850 r.p.m. Drive—Geared to and belted. Application—9 ft. dry pan. From extension shaft of dry pan to 40 ft. bucket conveyor and a 50 ft. x 24 in. belt conveyor.

One 40 h.p.; 850 r.p.m. Drive—Geared. Application—To an American No. 51 pug mill.

One 75 h.p.; 690 r.p.m. Drive—Geared and belted. Application—To No. 1 giant brick auger. From countershaft of brick augur to 30 ft. shaft, whch drives an 18-brick automatic cutter, three belt conveyors, a bucket conveyor, and a repress.

One 15 h.p.; 1,120 r.p.m. Drive—Belted. Application—Through countershaft to 140 in. blower; speed, 216 r.p.m., supplying draught for ovens.

Typical Drive in Common Brick Plant

Next we will take the motor drive used in a plant making common brick from soft clay which requires no screening or grinding. The daily output is 40,000 bricks. Soft mud machines, consisting of an upright receptacle with curved arms at the bottom to force the clay into press box moulds, are used. The moulds are fed automatically under a press, after being filled, and are moved forward to delivery tables.

Here one 60 h.p., 690 r.p.m., induction motor is used. It is belted by means of main shaft and countershaft to one combination pug mill and brick press, capacity 120 bricks per minute; one mould sander and one waste clay elevator to lift waste clay from brick machine to pug mill. The brick are air-dried, and cordwood is used to fire the kilns.

Lastly, we will consider the motor drive in a plant manufacturing pressed brick from a hard shale where the "dry machine" process is used. In this plant there are two separate and distinct units, each unit being driven by a 50 h.p. squirrel-cage motor. Each 50 h.p. motor is belted to a 9 ft dry pan and a brick press, as well as the necessary conveyors, cup elevators, etc. The moisture is added to the material in the dry pan, and the material is fairly dry when pressed. The kilns of this plant are fired with cordwood. Each unit is capable of turning out approximately 23,000 bricks an eight-hour day. When a large output is required both units can be run, giving an output of 46,000 bricks a day. Under this arrangement the plant is always run at high efficiency, and one unit is in reserve in case of any breakdown in the other unit.

A plant manufacturing ordinary drainage tile will have the same motor equipment as a brick plant. In fact, tile is often made in a brick plant by simply changing the dies on the auger machine so that the clay will be forced out in the form of a tube, whch is cut into the required lengths.

Sewer Pipe Plants

In a certain sewer pipe plant there is in use, or will be shortly, a total of approximately 235 h.p. in squirrel-cage induction motors. The raw material used is a weathered shale, which is brought to the plant by railroad. The shale is conveyed from the receiving platform and elevated to the storage room by means of two 5 h.p. motors, one operating the conveyor and one the elevator. The shale is first fed into a dry pan, which, along with the conveying belt and elevating cups, is driven by a 75 h.p. motor, belted to the load. From the dry pan the material is carried to the wet pans, three in number, where it is uniformly mixed. It is then conveyed by belts and elevators to the presses, where it is pressed into moulds, making the different size of sewer pipe, one length at a time. Special shapes of pipe are hand-moulded. The three wet pans and the conveyor belts are belt-driven by a 150 h.p. motor. The moulded pipe, after drying, is put in permanent kilns, which are fired by coal. The glazing of the pipe is done during the latter part of the firing.

Pottery and Ornamental Tile Plants

Here the nature of the work is such that individual motor drive offers many advantages. The use of belts and line shafting in factories of this type is especially disadvantageous on account of the fine clay powder which fills the air and collects on belts and pulleys, producing excessive belt slippage and large friction losses. The output of the plant is, in many cases, limited on account of the belt slippages. The use of individual motor drive will, in such cases, increase the output of the factory without any other increase in factory equipment, extra floor space, or labor.

In pottery and tile plants the charge, consisting of flint, feldspar and clay, is thoroughly mixed with water in a "blunger" mill. The "slip" is then sifted to remove lumps into an "agitator." Then the slip is pumped into a slip press, where the greater part of the water is pressed out. The wet clay, which is uniform in composition and free from lumps, is taken from the slip press. Up to this point the method of manufacturing pottery and ornamental tile is the same. For pottery the wet clay is pressed through a pug mill to distribute the moisture evenly and is then moulded into finished shape on "jigger" machines. For tile the wet clay is dried in racks and then passed through a crusher. After this it is ground into a fine powder in the dust mills. The fine, dry powder is then moulded into forms by presses, after which it is ready for the initial firing. The firing of the ware is practically the same in both cases. After initial firing the ware is decorated, refired, and glazed. Pottery is dipped entirely into the glaze and the tile is glazed on one side only. The ware is again fired, which completes its manufacture.

Some of the motor drives used in an ornamental tile and pottery plant are as follows. Sixty cycle squirrel-cage motors are used:

10 h.p.; 1,120 r.p.m. Drive—Geared. Application—Two double blungers.

3 h.p.; 1,120 r.p.m. Drive—Geared. Application—Sifters.

3 h.p.; 850 r.p.m. Drive—Geared. Application—Agitators.

5 h.p.; 1,120 r.p.m. Drive—Geared. Application—Slip pumps.

20 h.p.; 1,120 r.p.m. Drive—Direct connected. Application—Dust mill.

7½ h.p.; 850 r.p.m. Drive—Geared. Application—Pug mill.

15 h.p.; 690 r.p.m. Drive—Belted. Application—To several glaze machines.

An electric motor is also geared to a "grogg" pan, which crushes the broken sagars.

Porcelain Insulator Plants

Porcelain insulators which are made from "Kaolin," clay, and quartz, are manufactured much the same as pottery. The wet clay may be moulded in metal dies or on "giggers" for "petticoat" insulators, or forced through a tube machine in the shape of tubes or cylinders for tubes and bushings. The moulded pieces are thoroughly dried, then dipped in a glaze, which has been made the desired color, and again dried. This glaze has the same coefficient of expansion as the porcelain, and has no constituents to deteriorate. The insulators are fired in kilns, which are raised to a very high temperature for a few hours and then allowed to cool down slowly. Porcelain insulators must not only stand high voltages in many cases, but at times heavy mechanical strains.

In a certain electrical porcelain insulator works located in this part of the country there is a good example of individual motor drive. The principal machines are driven by 19 squirrel-cage motors, with a total capacity of 84 h.p. The motors are belted to the driven machines.

Blunger and agitators	1—10	h.p. motor
Pug mill	1—10	"
Large centre machine	1—15	"
Small centre machine	1— 7½	"
Clay lathes	1— 2	"
Giggers	2— 1	"
Finishing machines	6— ½	"
Grinding machines	1— 2	"
Glaze mill	1— 7	"
Grogg pan	1— 7½	"
Air compressor	1— 8	"
Water pump	1— 5	"
Machine shop line shafting....	1— 5	"
	19 84 h.p.	

The kilns in this plant are fired with coal.

The above gives an idea of the electric motor drive used in various kinds of clay-working plants.

One of the points of consideration in changing over from steam to electric drive is the method of drying the product. In those plants where heat exhausted from the kilns is used for drying or where drying tunnels are heated directly by coal or gas no change is necessary. However when exhaust steam is used it will probably be of advantage to consider some other method of drying in order to eliminate the use of boilers for this purpose only. Electric power for brick plants can usually be purchased from the central stations at a very attractive figure, due to the fact that the plant is usually shut down in cold weather. This means that the power requirements occur mainly in summer, when the central station load is otherwise at its lowest point. The point may be raised that the first cost of a number of electric motors in a large plant is greater than the cost of one steam engine. If you add to the cost of the steam engine the cost of the extra belting, shafting, etc., required, you will find that the first cost of the two methods of drive is approximately the same. When once installed the individual motor drive will effect a considerable saving over the central engine drive, both as regards cost of manufacturing and cost of plant maintenance.

Scientific and Industrial Research Council Holds Meeting

The Scientific and Industrial Research Council held a meeting at Ottawa at the close of last week, at which a number of important questions connected with Canadian industries were considered. A memorandum was forwarded to the government urging immediate action to make available the varied fuel resources within the boundaries of the Dominion for the use of the people of Canada in the coming year and placing the services of the Research Council at the disposal of the government to that end.

A grant was made for the purpose of carrying out an investigation on the utilization of the immense quantity of sulphite liquor which is now thrown away as a waste product by the pulp mills of Canada with a view to the establishment of certain new industries with this material as a raw product. The utilization of the waste ammoniacal liquor from Canadian gas works was also considered, this product containing large quantities of ammonia, which is of great value as a fertilizer.

Standardization of Engineering Products

The council, at the request of the Institute of Civil Engineers of Great Britain, also took steps to bring before the government and certain manufacturers of Canada the importance of Canada associating itself with the movement which has recently been organized in Great Britain, the United States, and France for combined action in connection with the standardization of various engineering products used and exported from these countries. This is a matter of great importance in connection with the building up of an export trade in this class of products by Canada at the close of the war. Connected with this the council is investigating a number of other questions which have been submitted to it dealing with post-war conditions with which our Canadian industries will be brought face to face upon the declaration of peace.

It was decided also to approach the Canadian Manufacturers' Association on the question of the development of trade organizations for the promotion of research, etc., in connection with groups of industries, such organizations having been developed with most beneficial results in Great Britain and in the United States. Co-operation along these lines is of the highest importance if Canada is to be able to hold her own in the keen competition which will develop in foreign markets with the cessation of hostilities.

The council decided to issue to the public a series of short bulletins dealing with some of the more important questions regarding the raw materials and certain manufacturing problems concerning which enquiries are being made at the present time.

Conservation of Fishery Resources

The council, in conjunction with the Biological Board of Canada, at a previous meeting, considered carefully the representations which had been made to it by the British Columbia canners' organizations and by private parties in that province on the subject of the preservation of the sockeye salmon of the Fraser River, the most important of the food fishes in British Columbia waters, and came to the conclusion that unless measures are taken very speedily the sockeye will soon be exterminated. The chief factors in this are the over-fishing of the sockeye and the obstructions that are offered to its ascent of the Fraser River to its spawning grounds in the upper reaches of that river. The first-named factor is by far the most important in this process of extermination, and it concerns international waters, through which the fish proceed from the entrance of the Strait of St. Juan de Fuca to the mouth of the Fraser River. Through the extremely large number of nets of all descriptions employed in these waters during the fishing season it is impossible for all but a minute percentage of these fish to reach their spawning grounds.

Resolution

On this subject the council passed the following resolution, which was communicated to the Minister of Marine and Fisheries:

"The Research Council and the Biological Board of Canada unite in recommending that the Dominion Government take steps to arrange a convention with the Government of the United States looking towards the appointment of an international commission which shall have the control of the salmon fisheries of the Fraser River and of all those waters through which the fish pass to reach the Fraser River, this commission to have full power to make and enforce regulations for the effective conservation and the restoration of these fisheries."

The international commission, as suggested, would have powers similar to those of the International Waterways Commission, appointed by the governments of Canada and the

United States. This, in the opinion of both the Research Council and the Biological Board, is the only way in which the sockeye salmon can be preserved and the canning industry of British Columbia continued.

Mainly Constructional

East and West—From Coast to Coast

The Board of Works of Peterboro, Ont., has appropriated $35,000 for its operations during the present year.

The City Council of St. John, N.B., has passed an estimate of $132,163.28 for expenditure on public works during 1918.

The value of the building permits issued in Welland, Ont., for the month of January is $20,410, as compared with $2,515 the same month last year.

The plant of the Ontario National Brick Company at Cooksville has recently been sold by the liquidators. The purchaser was Mr. F. W. Tofield, of Montreal, who represents Eastern interests, and the price paid was $250,000.

In the month of January, this year, there were 43 building permits issued in the city of Montreal, valued at $116,110. For the three years previous the figures were: 1917, 33 permits, $249,895; 1916, 44 permits, $174,160; 1915, 73 permits, $203,261.

The Toronto-Hamilton Highway Commission has consented to continue the maintenance of the Hamilton end of the highway on a "fifty-fifty" basis with the city. It was pointed out, however, that Hamilton must prepare plans before the end of the year for a permanent entrance.

Lanark County, Ontario, has submitted to the Provincial Minister of Public Works and Highways an estimate of $34,700 to cover construction work on county roads and $17,000 for maintenance for the year 1918. The 1917 expenditure was $43,536 on construction work and $12,743 on maintenance.

A syndicate has been formed which is to engage in steel and wooden shipbuilding at Vancouver. Negotiations have been entered into with the British Government regarding a contract for 12 vessels, and a total investment of $200,000,000 is planned for a permanent industry. Mr. E. F. Hutchings, of Winnipeg, is head of the corporation.

An international joint water commission appointed by the United States and Canadian governments recently met in New York to discuss means of eradicating pollution of those streams which touch both countries. A report is to be submitted to officials at Ottawa and Washington showing the extent of the pollution and suggesting remedies.

The preliminary survey for the overhead bridge on Hunter Street, Peterboro, Ont., will be commenced by City Engineer Parsons as soon as the weather permits. He has been instructed by the Board of Works to have plans prepared as soon as possible. One of the first steps in the preliminary work will be a series of borings in the river bed to determine the character of the foundations.

Reports are again being circulated, regarding the possibility of a merger between the Dominion Steel Corporation and the Nova Scotia Steel and Coal Company. For a number of years past attempts have been made to amalgamate the two concerns, and, while no definite results were obtained, it is now stated by large stock-holders in the former company that the deal will probably go through.

Hon. Frank Carvell, Minister of Public Works, has announced that the tenders received for removing the temporary bridge across the Kingston harbor used while the new causeway was under construction have been rejected, and that the department will remove the bridge itself and sell to the city of Kingston at a low price the timber, which it wants for the construction of a large public wharf.

The government plans to erect a nine-storey million-dollar office building in Ottawa to meet the growing demand for office space for the war departments. It will be built on O'Connor Street, on the site at present occupied by the old fisheries museum, which is now to be torn down. Several other buildings will also have to be expropriated in order to provide the necessary space. Plans for the new structure are under way.

The Water Board of the Greater Winnipeg Water District have let the contract for the laying of the pipe line from Deacon to Winnipeg to Thomas Kelley & Sons, at $292,215. The contract for the supply of the pipe and the fixing of the joints in the trench was let to the Canada Lock Joint Pipe Company, Ltd., their figure being $190,311. It was decided to use reinforced concrete pipe in preference to cast iron, owing to the cheaper cost. The cost of the former laid and completed will be $482,626, this total being $76,731 below the estimate for the cast iron pipe.

As a result of a conference between the Toronto-Hamilton Highway Commission and representatives of the various municipalities interested in the highway, the Ontario Government will be urged to allow a speed limit of thirty miles an hour to motor-driven vehicles on the new highway and roads outside the city. Should the government be averse to granting this general speed limit, the commission will ask for permission to fix their own limit on the Toronto-Hamilton road. They will also request authority to compel commercial vehicles using the highway to carry lights.

Since the adoption of a good roads system in Lincoln County, Ont., in 1917 good progress has been made both in construction work and organization. Twenty-two roads are included, and are so arranged as to benefit all portions of the county. Work has been done in the Township of Gainsboro, the village of Smithville, and along the entire length of Road No. 1, and a bridge has been erected at a cost of $3,000. The Niagara and Homer Road has been improved from Homer to the Township of Niagara; also the Creek Road in St. Davids. About twenty reinforced concrete culverts have been built in various parts of the county. In order to facilitate the work and shorten hauls it was decided at the recent session that the council should purchase a quarry and stone-crushing equipment.

Personals

The following officers were elected for 1918 at the recent annual convention of the Association of Dominion Land Surveyors: President, J. N. Wallace, Calgary; vice-president, J. R. Aikens, St. Catharines, Ont.; secretary-treasurer, Major E. W. Hubbell, Ottawa.

Mr. William Gore, of Toronto, who has been elected a member of the Canadian Society of Civil Engineers, was at one time with the Fowler Waring Cable Company, London, Eng., engaged on the design of telegraph, submarine, and telephone cables and the machinery for their manufacture. He is now consulting engineer to the John verMehr Engineering Company, Toronto.

Obituary

Mr. Sam. Newmarch, railway contractor, who for many years has been engaged in railroad construction work in Winnipeg and the West, died suddenly at his residence in Vancouver on February 3. Mr. Newmarch was superintendent of the gang of construction men sent from Canada to construct the road at Kola Bay, Russia.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brandon, Man.
The City Council contemplate the purchase of waterworks equipment costing $33,000. Clerk, H. Brown.

City Council contemplate the construction of a watermain costing $60,000, First St., Pacific Avenue to Asylum. Clerk, H. Brown.

Daysland, Alta.
Provincial Government contemplate construction of two drainage systems. Provincial drainage engineer, A. McDonald, Edmonton.

London, Ont.
City Council will construct an eight-inch sanitary sewer costing $3,500 on Cheapside Street. Engineer, H. A. Brazier.

Milk River, Alta.
Town Council contemplate grading and construction of cement walks. Secretary-treasurer, Mr. Heming.

North Vancouver, B.C.
City Council contemplate the erection of a $50,000 filtration plant. Engineer, A. H. Clucas.

CONTRACTS AWARDED

Alberta, Province of
Mr. Sheppard, Halcourt, has the general contract for $4,000 bridge over Red Willow River for the Department of Public Works, Provincial Government.

Prince Rupert, B.C.
The Grand Trunk Pacific Railway plan to build brick station, machine shop and round house, also 1,000-foot wharf, at a cost of $250,000. Manager, W. P. Hinton, Winnipeg.

St. John, N.B.
Department of Public Works, Dominion Government, contemplate the erection of an extension to breakwater from Negro Point to Partridge Island. Secretary, R. C. Desrochers, Ottawa.

Three Rivers, Que.
The Canadian Pacific Railway, head office, Montreal, propose to erect a $30,000 station at Chamflour and St. Maurice Street. District engineer, P. Harper, Old Dalhousie Station, Notre Dame Street, Montreal.

Public Buildings, Churches and Schools

Halcourt, Alta.
The East Red River School District contemplate the erection of a school. R. Adams, A. Chapman and Mr. Whistler are trustees.

Halifax, N.S.
The Navy League of Canada contemplate the erection of a home costing $100,000. Secretary-treasurer, M. P. Fennell, Harbor Board Building, Montreal.

E. E. Boleman, 17 Longard Road, is preparing plans for "St. Joseph" church for the Roman Catholic Episcopal Corporation, Dresden Row.

Milk River, Alta.
The erection of a Union church costing $4,000 is contemplated. Address, Methodist Pastor.

Ottawa, Ont.
Tenders are being received by the architects, J. A. Pearson and J. O. Marchand, Centre Block, until noon, March 18, for heating and ventilating equipment for the Parliament Buildings for the Department of Public Works, Dominion Government. Plans and specifications at office of the general contractors, P. Lyall & Sons Construction Co., Ltd., Parliament Buildings.

Peterboro, Ont.
The Masonic Lodge contemplate the erection of a masonic temple.

Quebec, Que.
L. Auger, St. John Street, is preparing sketch plans for $100,000 four-storey stone building for the St. John Baptist Society.

J. E. Tanguay, 20 D'Aiguillon Street, is preparing plans for $10,000 addition to "St. Maurice" school for the Roman Catholic School Commission.

Renfrew, Ont.
Town Council will make repairs to municipal office building at Raglan and Railway Streets. Secretary-treasurer, J. A. Devenny.

Spir, Ont.
The School Board will call tenders shortly for the erection of an $8,000 one-storey tile school. Architect, W. W. La Chance, 275 Jarvis Street, Toronto.

Strangfield, Ont.
The School Board contemplates the erection of a $4,000 school. Secretary, Amos Waite.

Trail, B.C.
The erection of a $24,000 addition to Central school by the School Board has been recommended. Secretary, F. E. Dockrill.

Trout Creek, B.C.
The Military Hospitals Commission, 22 Vittoria Street, Ottawa, contemplate the erection of a sanitorium. General superintendent, J. H. W. Bower.

Vancouver, B.C.
The Navy League of Canada contemplate the erection of a home costing $30,000. Secretary-treasurer, M. P. Fennell, Harbor Board Building, Montreal.

CONTRACTS AWARDED

Kentville, N.S.
C. H. Wright, Main St., Wolfville, has the general contract for three-storey sanitorium for the Military Hospitals Commission, 22 Vittoria Street, Ottawa.

Kingston, Ont.
H. Hunter, 332 Barrie St., has the general contract for convalescent hospital for the Military Hospital Commission, 22 Vittoria Street, Ottawa.

Business Buildings and Industrial Plants

Edmonton, Alta.
C. Cockshutt Plow Co., Ltd., 9909-101st Ave., will rebuild their store and building which were recently destroyed by fire.

Fort William, Ont.
The Canadian Car & Foundry Co., Ltd., 1209 Laughton Ave., contemplate the erection of a steel shipbuilding plant. Superintendent, Mr. Elster.

Fredericton, N.B.
The Hartt Boot and Shoe Co., Ltd., York Street, contemplate the erection of a $50,000 factory. President, Mr. Palmer.

Guelph, Ont.
G. B. Ryan & Company will rebuild their general store, etc., on Wyndham Street, which were recently destroyed by fire.

Halifax, N.S.
Gunn & Co., Ltd., Campbell Road, contemplate the erection of a building and warehouse.

The Modern Garage Limited have secured a site on which they plan to erect a garage, show room, etc. Superintendent, Jos. M. Tobin, Dennis Bldg.

Lethbridge, Alta.
R. C. Harvey, 631-5th St. S., contemplates extensive addition to farm buildings.

Ottawa, Ont.
Alex. Garvock, Jr., 136 Lewis Street, general contractor for $60,000 warehouse for A. L. Florence, Redpath St., will let plumbing, heating and electrical work.

Renfrew, Ont.
W. T. Guest contemplates the erection of a $5,000 two-storey brick veneer business block on Raglan Street, to replace one recently destroyed by fire.

Toronto, Ont.
The Swift Canadian Company, Keele and St. Clair Avenue, will erect concrete and brick addition to boiler house, etc., costing $9,500.

Plans are being prepared for factory building for the Board of Control for the manufacture of cars.

J. H. McDonald, 887 Bloor West, will erect a $3,000 brick addition to his coal warehouse and garage.

Vancouver, B.C.
The Dominion Canners, Limited, head office, Landed Block & Loan Bldg., Hamilton, Ont., contemplate the erection of

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Snow Removal on Rural Roads

LAST week's Contract Record quoted the experiences of two or three road engineers in regard to snow-cleaning methods and possibilities on rural roads. In urban districts, snow removal is an absolute necessity and requires competent organization to produce effective results. The intricacy of traffic requirements on city streets makes it almost impossible to take half-hearted measures. On the other hand, there have been no very exhaustive attempts, heretofore, to keep country roads passable in the winter time. Traffic on such highways has been largely confined to the horse-drawn variety and almost entirely localized. Long-distance motor travel has scarcely been considered, and if considered, has been set aside as impossible.

The vast improvements effected to country highways in recent times, has opened the question, however, of the possibility of making such improvements available for twelve months of the year instead of, perhaps, eight. The more universal adoption of hard-surfaces is adding force to the arguments for passable roads in the winter season. Long stretches of inter-urban and cross-country roads of durable construction are now going to waste for four months every year, due, simply, to the effect of snow. If there were adopted suitable measures for maintaining unrestricted travel, there would no doubt be sufficient motor traffic of a commercial character to justify the trouble and expenditure necessary.

The railway congestion and general transportation demoralization this winter has added force to the argument for clear through routes. Commercial traffic on a fairly large scale would, we think, make use of inter-urban routes if such were available. This would, in a measure, relieve the congestion of the railways by permitting movement of short-distance freight.

The article published in the last issue of the Contract Record instances two methods that have proved very effective. Obviously, conditions do not permit of an adoption of a uniform means of snow removal, but there are in the two cases cited, some very valuable suggestions that, no doubt, are applicable to most conditions obtaining in the greater part of Canada. Perhaps the most notable instance of rural snow cleaning that has come to notice is Pennsylvania's work in keeping a 225-mile stretch open for army transport trains. The system for handling this work expeditiously is commendable, and the results of these attempts open the way for the wider adoption of similar measures.

Montreal Builders Favor Labor Importation

AT a recent meeting the Montreal Builders' Exchange passed a resolution in favor of the limited importation of Asiatic labor, under well-defined regulations, and instructed the secretary to write to the federal premier, the federal minister of labor, and Lord Shaughnessy to this effect. The question was introduced by Mr. Fred B. Locker, who called attention to the shortage of labor in certain trades and the difficulty the Dominion was experiencing in securing a sufficient supply of unskilled workers. He complained of the attitude of organized labor towards the importation of Asiatics, and pointed out that such a step was in the national interest, as the shortage of labor was largely responsible for fuel and transportation troubles.

"Organized labor," said Mr. Locker, "seems to be gathering strength from the war, and is now so strong and selfish that it had already persuaded our professional politicians that it is too important to do its share on the battlefield and that it must stay at home to make the bullets for others to fire. The professional politician says, 'Right you are, labor,' and labor retorts: 'Yes, but we want more wages for staying at home and working.' And while other citizens are gone fighting, labor demands higher wages and more advantages.

"We at home are cold and need coal, and ask that 30,000 Chinese coolies be imported to cut our wood and to hew our coal; but labor says: 'No, you shall not, lest some of our advantages be curtailed.'"

Another matter discussed at the meeting was the amendments to the Workmen's Compensation Act. W. M. Irving reported that these had been examined by the legislation commitee, and, taking into account the increase of wages since 1909 and the higher cost of living, it was considered that the proposed increases under the various sections, viz., from $2,000 to $2,500, from $600 to $800, and from $1,000 to $1,200, were justified. His committee, therefore, recommended that no further action be taken. The report was adopted unanimously. The legislation committee, which is composed of W. M. Irving, convener, and Messrs. Munn and Walsh, was continued, and instructed to examine and report on the working of the Ontario Workmen's Compensation Act, with special reference to the obligations of Quebec contractors and sub-contractors who engage in construction work in Ontario, and also as to the position of Quebec workmen who engage in either province for work in Ontario.

The secretary submitted correspondence he had had with the Hon. L. A. Taschereau regarding the proposed bill for the protection of public buildings against fire. The minister had agreed to receive a deputation from the exchange in this connection, and, as the proposals affect not only general contractors but heating and electrical contractors, it was agreed that A. H. Vincent would obtain the views of the electrical contractors and J. E. Walsh those of the heating contractors, and report as early as possible.

President Anglin, with the advice and consent of the directors, appointed the following standing committees:

Membership — First Vice-President Dykes (convener) and Messrs. Locker and Smallpiece.

Rooms and Rules — Second Vice-President Irving (convener) and Messrs. Ramsay and Webster.

Audit and Finance—J. E. Walsh (convener) and Messrs. Fussing and Vincent.

More Effective Fire Protection for Public Buildings in Quebec

MORE effective protection for public buildings is provided in a bill now before the Quebec Legislature, entitled, "An Act for the Protection of Public Buildings Against Fire." Several clauses apply to electrical installations and heating apparatus. These are as follows:

No electric installation in a public building in the province for the transmission of light, motive power, or heat shall be put in or altered except by a person or under the immediate supervision of a person duly authorized and holding a license to that effect.

Every heating apparatus already installed in a building or to be so in future, must be approved by one of the inspectors of public buildings, who shall give the proprietor of the building a certificate to that effect. This certificate must be always posted up at the place indicated by the inspector.

The Lieutenant-Governor-in-Council may prescribe the conditions on which the license provided for above shall be issued, its duration, and the fee chargeable thereon. He may likewise prescribe such conditions as he may deem fair and reasonable respecting the installation of a heating system in a public building, as well as the conditions on which the certificate provided for above shall be issued, its duration, and the fees chargeable thereon.

The chief inspector of public buildings may, with the approval of the Minister of Public Works and Labor, declare any electric installation or heating apparatus now in any public building defective, and may order the necessary alterations to be made; and, if the proprietor does not comply with the said inspector's orders to that effect, he shall be liable to the penalties provided.

Problems Confronting the Canadian Society of Civil Engineers

"PROBLEMS Confronting the Society," was the subject of an address by Mr. H. H. Vaughan, president of the Engineering Institute of Canada, at the regular monthly luncheon of the Ottawa branch of that organization on Thursday afternoon.

The speaker referred at some length to the decision that had culminated in changing the name of the society from the "Canadian Society of Civil Engineers" to "Engineering Institute of Canada." While the change may have its demerits as well as its merits, personally he felt that it should add virility and prestige to the profession. It was undoubtedly the intention to give the mechanical, mining, electrical, and other branches of engineering an equal footing and share in the organization. To do this it was essential to further supplement the membership from other fields of engineering than that technically known as "civil." Further, such members must be adequately represented on the council by men in the forefront of the respective branches of the profession. The speaker referred to his own election as president of the institute as already being a recognition of the mechanical engineers.

This should be followed by the formation of sections in each of the institute's branch organizations, to take care of the interests of the electricals, chemicals, mechanicals, etc., so that concerted action may be taken in municipal and provincial affairs as representing the engineers of Canada.

The reports and papers hitherto presented at the annual meetings have not been considered by the branches. It was suggested that committee reports should be submitted in time to allow of their being sent to the branches for criticism, which could, in turn, be submitted to the annual meeting.

It was further proposed to hold general district or provincial meetings each year in each province, preferably in industrial centres, where technical papers would be read and discussed, industries inspected, and ideas interchanged.

It is possible that uniformity of legislation should be urged for each of the provinces, so that qualified men would be able to practice in any part of Canada. If legislation defining the status of the engineer and limiting the practice of the profession to members of the institute is desirable, it should be of such a nature as to permit the practice of engineering by any member in whatever province such legislation may be effected. Mr. Vaughan pointed out particularly that legislation of this kind may be simple enough in respect to civil engineers, but is a very difficult and complex matter in so far as, for example, the electrical and mechanical practitioners are concerned.

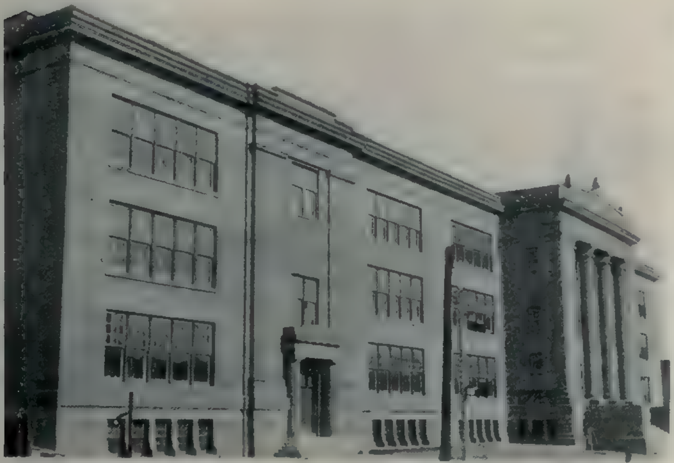
In general, the engineering profession should take a more outstanding position in municipal, provincial, and national affairs than it has hitherto done. There is an awakening recognition of the importance of the engineer, and efforts should be made to keep the influence of the profession on a high plane.

Mr. Vaughan pointed out that engineers might well take a more prominent part in the solution of the fuel-power situation in the Dominion. No body of men is better fitted by training and experience to assist in evolving a comprehensive policy for the Dominion to realize the inestimable advantages of a co-ordination of the water-power and the fuel resources of Canada.

The Largest Public School in Canada

Park School in Toronto with Accommodation for 1700 Pupils—Description of Its Design and Construction—Cost $188,000.00

THE largest public school building in Canada is the Park School, at Toronto. The new building, which is just nearing completion, replaces the old Park School, one of Toronto's most historic educational institutions, and the motives for its erection were lack of accommodation and a need of better lighting and ventilating conditions. It is expected that during the spring the new structure will be occupied and the old Park School will, in all likelihood, be demolished. The new school cost $188,000.



The Park school is the largest building of its kind in Canada.

The site of the new school is on the north side of Sydenham Street, between Sumach and Sackville Streets, to the south of and adjoining the old school property. The building is in the form of a T, 272 feet across the front by 69 feet in depth, with an extension of 55 feet by 72 feet, and all three storeys in height. It contains 34 ordinary classrooms, each seating 50 pupils, the total of such accommodation being about 1,700 pupils.

In addition to these classrooms there are two larger and special rooms to accommodate the departments of household science and manual training. A kindergarten room, which is double the size of the ordinary rooms, is located on the ground floor, and so arranged that it can be thrown open in combination with a large hall space, thus providing a large audience room without the cost of making part of the building exclusively for that purpose. This combination has been made a feature of the Toronto public school buildings for a number of years.

Between the main entrances is the principal's office, with waiting-room and supply-room adjoining. Passing through the main vestibule, one enters the large rotunda, with wide corridors running east and west, with classrooms on either side. The lighting of these classrooms is by large group windows, on one side only, to the left of the pupils, in accordance with well-established practice in modern school architecture. The classrooms on all floors are laid out similarly on either side of longitudinal corridors.

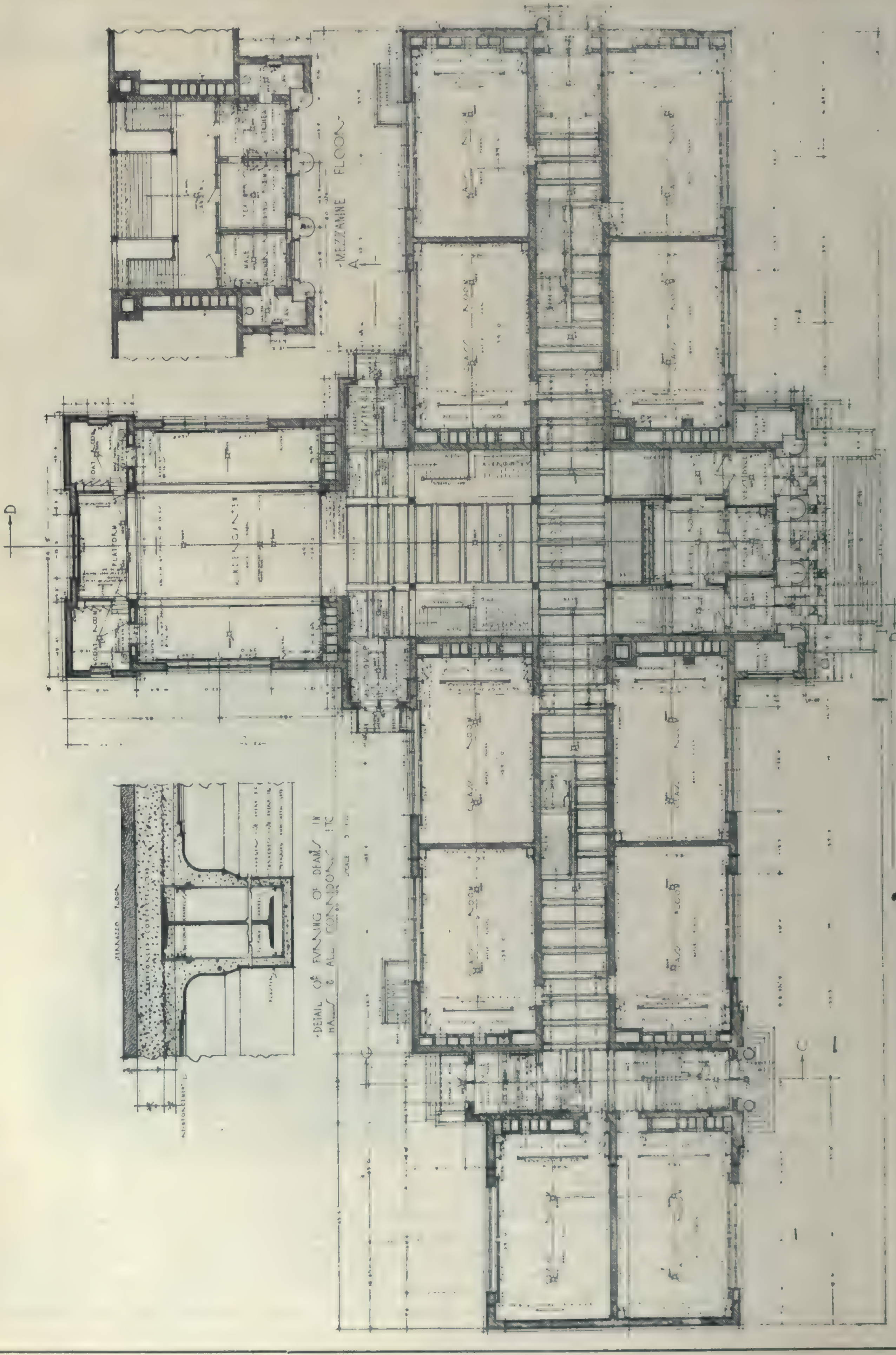
Suitable rooms are provided for various purposes, such as teachers' lunch rooms and rest rooms, storerooms, medical inspection rooms, and lavatories on each floor for both teachers and pupils.

The basement, which is well above grade, ensuring good light and ventilation, has a number of exits direct to the school yard, and contains girls' and boys' assembly rooms, a large drill room, and pupils' lavatories.

The exterior design is Greek, as near as can be adapted to modern school work, with strong, plain lines, both imposing and interesting. It is carefully worked out in well-balanced proportions. The walls are faced with first-class red stock brick and trimmed with New Brunswick sand stone. The photographs reproduced herewith give an idea of the exterior and the entrance. Besides the main entrance there is another on the front with two on the east and two at the rear.

In construction the building has concrete foundations, with brick walls and partitions. Stone is used as trim for the entrance columns, doorways, and steps, coping, cornice belt courses, sills, and lintels. The columns are surmounted with carved capitals. The brickwork is plainly carried out, except for large panel work on the sides. The main partitions are of brick, with a few 4 and 6 in. tile secondary partitions dividing the principal's office and waiting-rooms, lavatories, manual training room, and domestic science room. On the ground floor the outside walls measure [illegible]

The entrance to the Park school.

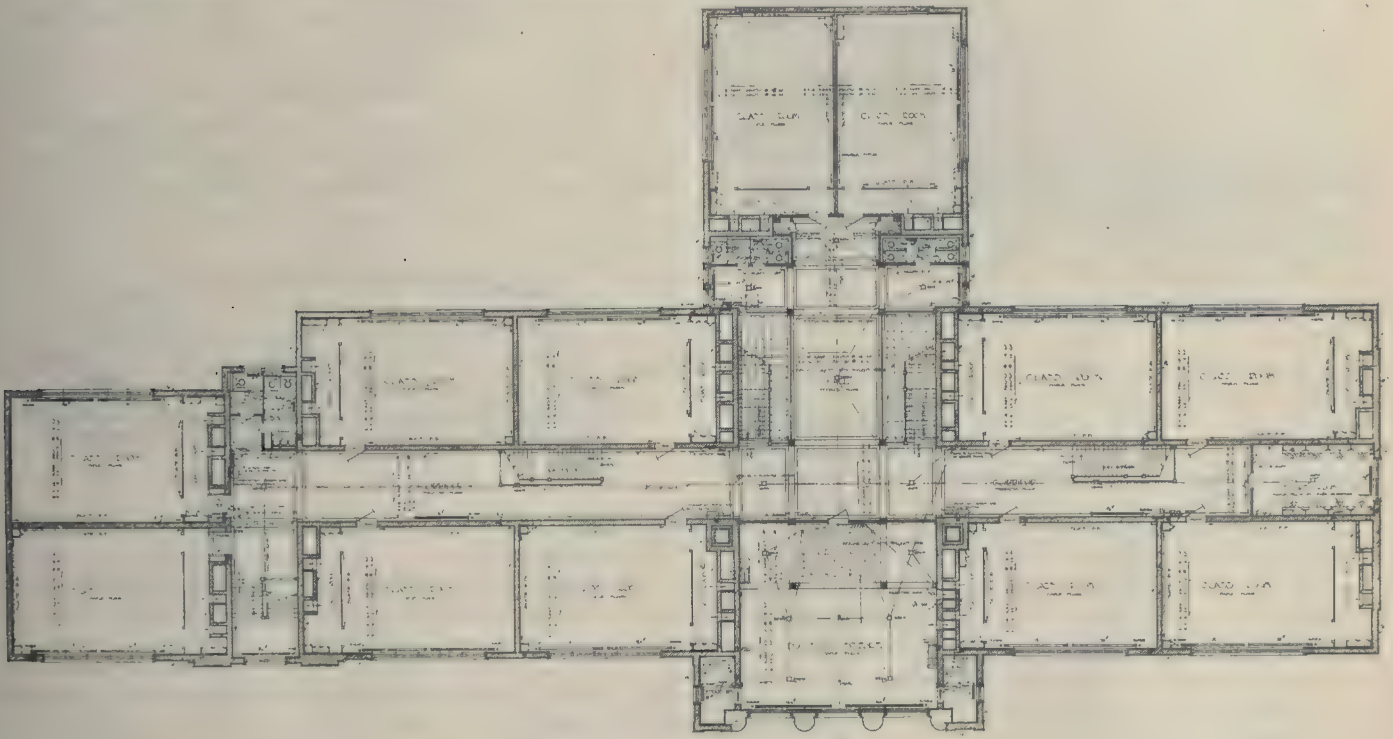


Plan of ground floor.

inches, and partitions are 14 inches, while these are 14½ inches and 9 inches respectively on the upper storeys. The stairs throughout are of iron. The floors of the classrooms are of wooden joist construction, with a maple surface. In the corridors a 4 inch reinforced concrete slab is used, with I-beams spanning from wall to wall. The beams are boxed in and plastered so as to present a plastered beamed ceiling. The concrete slab is surfaced with terrazzo. Concrete has also been used for side and rear steps and vestibule.

The storey heights are: Basement, 11 ft. 6 in.; ground and first floors, 14 ft. 6 in.; second floor, 13 ft. The boiler-room floor is 5 ft. below the general basement floor level. A mezzanine is located in the corridor, just above the main entrance. This contains a kitchen and teachers' dining and rest room. The classrooms measure about 24 ft. x 39 ft., including a cloakroom at one end. They are lighted by a group window, 22 ft. long, containing 5 units.

The construction is what is termed "second class," but all corridors, stairways, and exits are "first class fireproof construction."



Plan of first floor of Park school.

The plumbing, heating, and ventilating are complete in every detail, and no pains have been spared to make this one of the most sanitary and up-to-date installations of any school in the country. The classrooms, in addition to being heated with direct steam radiation, are ventilated with a modern system of forced fresh, warm air. The fresh air intakes are located at the sides of the main entrance.

The following is a list of the contractors: Masonry, Lucas & Son; carpentry, William Williamson; plastering, Beaver & Son; painting, J. Bell; heating and plumbing, Purdy-Mansell, Ltd.; iron stairs, Canada Wire and Iron Goods Company; roofing, W. E. Dillon; leaded lights, Luxfer Prism; reinforced concrete, A. C. Richmond; heat regulation, Johnson Temperature Regulation Company; electric wiring, A. R. Rice; terrazzo floors, Venetian Marble and Mosaic Company; drains, Britnell Contracting Company.

New Water Works System at Cap de la Madeleine, P.Q.

By Romeo Morrissette

A NEW water supply and distribution system has recently been completed in Cap de la Madeleine, P.Q. The installation was rendered necessary on account of the rapid growth of the village, the development of which has been very much promoted by the location of new industries within the municipality. The most recent of these is the Tidewater Shipbuilding Company, which has under progress the equipment of a shipyard. Two years ago the St. Maurice Paper Company built a large plant. The village has recently applied to the Quebec Legislature for incorporation as a city, and the charter has been granted.

In the season of 1916-17 the village council received from a private company, promoted by Mr. Alphonse Aubin, of St. Jerome du Lac St. Jean, an offer for the installation of a water supply system. The council granted to this company a franchise, by which the latter agreed to build the whole system at their own risk and expense. The municipality reserved for itself the right to buy within sixty days after its acceptance by the municipal council, represented by a technical expert, or in any time after five years. In the former case, the price to be paid was the cost of the system by unit of measurement. In the latter, the price was the capital represented by the revenue of the system at that time on a basis of 5 per cent. of interest. The company issued their own bonds, which were disposed of by the Canadian Bond Company, of Montreal.

The geological formation at Cap de la Madeleine comprises a sand stratum over a clay stratum. The sand extends under all the city to a greater or less degree of thickness, and it is easy and inexpensive to sink wells to such water-bearing sand. The water is pure and cold. For this reason the engineers planned to pump the water from a series of pipe wells directly to a main pipe or reservoir. The engineer in charge of the work was Mr. J. H. Grenon, of Chicoutimi, and Mr. G. C. Bastein, C.E., acted as technical expert for the municipality.

Pumping Station

The pumping station is a frame house 18 ft. x 24 ft., with a concrete floor. Space was designed for two pumps, but last year only one was placed. This is of the centrifugal type, with a capacity of 450 gallons per minute, under a head of 125 feet. It is driven by an electric 25 horse-power motor. The diameter of the pump is 6 inches, and it is connected to a 10-inch main and to an 8-inch pipe leading to the reservoir. Valves have been installed in order to control the whole system from the pumping station and also to permit the cleaning and repairing of any part of the system directly from the same station. The work has been performed by the general contractor, Mr. Alphonse Aubin.

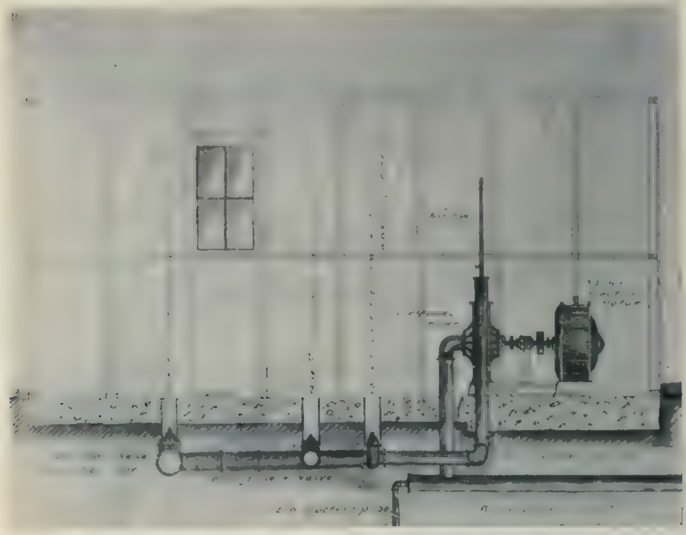
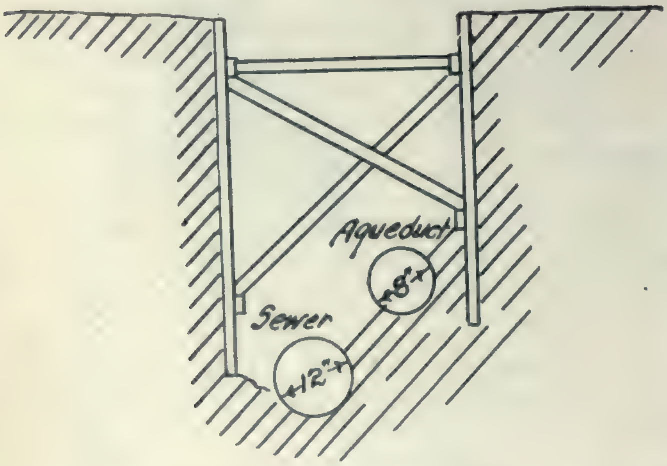


Diagram of pump-house and valve arrangement.

The Reservoir

The reservoir is located on the hill 60 feet above the pumping station and 6,300 feet from the village. It is circular, with a diameter of 86 feet at the top and 50 feet at the bottom. Half-inch twisted steel bars on ¾-inch twisted steel bars were used as reinforcement. The reservoir is waterproofed with a 3-inch thickness of grout, embodying 10 per cent. of Toch cement.



Arrangement of sewer and water pipes.

Mr. O. Arcand, of Three Rivers, was the contractor for this reservoir, which cost $4,000.

Pipe Laying

Pipe laying was done according to the following schedule:

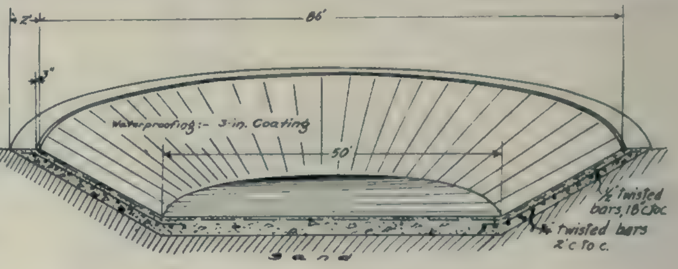
Diameter.	Amount.
10-in.	3,980 feet
8-in.	8,100 "
6-in.	16,542 "
4-in.	821 "
2-in.	3,936 "

Trenches were opened for a distance of 33,400 feet. Sub-contracts for the digging of trenches were given to John Boivin, W. Binette, and O. Pronovost, at 25 cents per cubic yard. The laying of pipe cost 8 cents per lineal foot, and the pipe cost approximately $60 per ton. It was furnished by Messrs. Therreault & Racine, from Quebec.

Forty-six fire hydrants were placed, at $75 each, and 45 valves, at $40 each.

Sewer System

Vitrified clay sewer pipe was placed alongside the aqueduct, with a gradient varying from 0.20 per cent. to 2.00 per cent. The price for the laying was 10 cents per lineal foot, and the job was carried out by the same contractors.



Showing half of concrete reservoir.

Forty-two concrete manholes, at $45 each, were placed; also 15 vitrified clay pipe catch-basins.

The Court of Appeal, Montreal, has reversed the judgment of the Superior Court in the case of Quinlan & Robertson, contractors, Montreal vs. the City of Maisonneuve. The contractors claimed the interest coupons, of the value of $12,420, on certain bonds issued in payment of the construction of the boulevard, and refused the bonds without the coupons. The Superior Court allowed the sum of $5,755, but the judgment has been reversed by the Court of Appeals, who allowed the full amount claimed. Mr. Justice Cross, however, dissented, on the ground that the full amount would represent more than the contract price for the work.

A town-planning and rural development Act has been passed in Saskatchewan. The Act contains a number of new features which are improvements on previous town-planning legislation. There are now six provinces in Canada with town-planning and development Acts.

The fourth annual meeting of the Ontario Safety League was held in the Council Chamber of the Board of Trade, 19th floor, Royal Bank Building, Toronto, on Monday, February 4th.

Low Grade Fuels for Clay Working Plants

Paper Before C.N.C.P.A. Describes How the Installation of Forced Draft in Brick Kilns Makes Lignite Fuel Available

By W. G. Worcester*

IT is the final stage of clay product manufacture, the burning, that causes the greatest concern to the clay-worker, not only because of a desire to procure a 100 per cent. burn, but also on account of the increasing price and scarcity of fuel. This is influencing the clay product manufacturer to turn his attention to the matter of improved kilns, furnaces, and burning conditions, in order that there may be obtained from his fuel the greatest possible amount of work value per ton, cubic foot, or gallon, as the case may be.

If the investigation is extended far enough there will be found available at the present time some very excellent and highly efficient equipment for the conservation of fuel. These ideal conditions will be found in the continuous kiln, the gas producer (used for either continuous or periodic kilns), the tunnel kiln, which, theoretically, offers great possibilities, and, in addition to the above, though in no manner belonging to the same class as a fuel economizer, there might be added the use of force draft, which, as will be shown, offers economical possibilities considerably in advance of those to be derived from the natural draft method so commonly used.

Poor Fuels Burned With Forced Draft

The writer does not wish to give out the impression that force draft would prove economical under all conditions, or that he would recommend its use or installation by any company financially strong enough to fortify themselves with a continuous kiln or gas-producer. Where there is one company in the industry, however, able to embark with a continuous kiln, there are scores that must creep before they walk. It is to the latter that the use of force draft may prove of assistance, especially in those districts where cheap coal or screenings are available; and, in the provinces of Western Canada where vast deposits of brown or lignite coals prevail, these latter coals slake or crumble very easily upon exposure to the air, and eventually will reach a stage where it becomes nearly impossible to use them for brick-burning in the ordinary way with natural draft. A personal study of these low-grade coals in Alberta, covering a period of nearly four years, convinces the writer that, even though they be badly weathered, they can be burned successfully with force draft.

The application of forced draft to the clay industry is of comparatively recent origin. As far as the writer has been able to learn, it remained for Mr. J. C. Boss, of Indiana, to advocate its use for brick-burning. Mr. Boss designed a suitable means for applying it to kiln furnaces, for which he was granted a patent a number of years ago, and at present has many installations throughout the country. Since the Boss system was brought out there have been other systems or methods devised to accomplish the same purpose. To be more specific, there is in use at Crawfordsville, Indiana, on three brick yards, a special grate for the use of force draft that had its inception some nine years ago. During the past year I have been associated with one of the above plants, where I have made a careful study of the burning system as used at that point. In presenting the result of my observations and deductions my object is to bring to the attention of clay workers a possible means of reducing their burning costs.

Force Draft System and Equipment

The primary feature of force draft is some mechanical means of supplying a relatively large volume of air under low pressure. This is usually supplied by a fan or blower, similar in design to those used on waste heat dryers, the size naturally depending on the number of kilns or bricks to be burned at one time. An average installation for a plant of fifty thousand building brick capacity would be a fan similar to a No. 80 of the American Blower Company make, this fan having a wheel with a diameter of 48 inches and a face of 24 inches, in a bottom horizontal discharge housing, and operating at approximately 600 r.p.m. With the above conditions there is available at the kilns an ample supply of air under a pressure of 1¾ inches. It is quite obvious that it is necessary to have an excess of air at all times in order that there may be a sufficient volume to care for at least five round 30-ft. kilns at the same time; otherwise, as each succeeding kiln is added, the volume and pressure per kiln will reduce, with a consequent alteration of the burning conditions.

The necessary power to operate the fan would naturally be consistent with that of the main plant, electric or steam, though a gas engine would answer very well. The main requirement is that of a fairly constant speed.

To keep the yard and kilns free from an overhead system, which is not only unsightly but cumbersome as well, the use of underground flues is to be recommended; these should be as nearly airtight as possible and free from sharp turns or bends. While in some cases the flues have been constructed of brick, trowled on the inside with cement, they are not as satisfactory as the ones built from sewer pipes. In most sewer pipe yards one can usually purchase seconds or culls at a greatly reduced price, which for air ducts are just as serviceable as No. 1's.

Furnace Design

There should be installed in the main lines, as well as in the individual branches to each kiln, suitable dampers to permit of repairs and extensions without shutting down the blower. In addition, though not absolutely necessary, it is advisable to have dampers at each furnace, which will assist the burner very materially in regulating the heat of the kiln.

From the branches which pass around or along the sides of each kiln there must be led to the individual furnaces feeder lines (3 in. or 4 in. pipes). These feeders open into air chambers under each furnace, which are about 18 in. deep, 12 in. wide, and 24 in. long, the top being fitted with a frame or casting, which receives and holds the grate in place.

The grate is an ordinary casting, 11 in. x 22 in., having a smooth upper surface next to the fire and with reinforcement ribs on the back to prevent warping; in it there are drilled nine rows of 3/16 in. holes, 20 holes long, 180 in all. It has been found that a large number of small holes give better results than the same opening area furnished by fewer larger holes — in other words, a better combustion of the fuel is obtained.

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*Secretary of the Alberta Clay Products Manufacturers' Association.

The fire-box or furnace proper differs but little from that of an ordinary grate furnace, the main difference lying in the fact that it is not quite so wide and that there is but one opening, an ash-pit not being necessary.

Burning Procedure

Any description that may be given as to the actual procedure for burning by the system under discussion must, in the nature of the case, be generalized only. This is apparent when one reflects for a moment that coals and clays differ very widely, so that what might prove suitable in one case would not answer at all in another. For this reason, a brief description of the methods employed at Crawfordsville in the burning of 10-pound paving blocks will be given as a representative example. When a kiln is ready for lighting the furnace doors are swung back; three small scoops of coal are placed in the furnace rather evenly over the grate surface; after each furnace has been thus treated the air is turned out about one-half, a small scoop of fire from a nearby kiln is deposited in each furnace on top of the coal, and in a few minutes a brisk fire is burning. The air is then reduced to a point where the fires will burn slowly but steadily. New coal is added about once per hour, care being taken to place it at the back or sides of the grate, rather than directly upon the previous firing, for by so doing very little smoke is produced, thus reducing the chances for sooting up a kiln. At the end of about 36 hours, during which time the doors have been left open, the water-smoke is nearly off and the furnaces are fairly well filled with ashes, which are raked out clean, and, with the doors still open, the firing is increased, with a little more air added. At the end of another six or twelve hours the water-smoke is off, the doors are then closed, except for a three-inch opening at the bottom. The air is now put on in full, registering one and one-half to one and three-quarter inches by a "U" tube. The firing interval is gradually increased from 45-minute intervals to a 30-minute schedule, which is continued for the next 72 hours; at the end of this time the kiln shows a good, even heat through and through, and will have from a half to an inch settle.

Temperature Kept Steady

During the stage just passed—that of heating up—the fires have been cleaned or clinkered once during each eight hours. From the time the kiln starts to settle the aim is to hold the temperature steady, without any further increase—just sufficient to maintain approximately a settle of one-quarter inch per hour until the desired amount has been reached (12 inches with the material in question). Ordinarily the fires are cleaned once in each eight hours during this period, as in the preceding one, but, should the settle gain too rapidly, the periods of cleaning may be lengthened somewhat. If a kiln is working properly the doors are frequently left up the three inches, as in the heating-up stage, to the finish of the burn. However, at times, especially on windy days, the heat will have a tendency to leave the heads and run to the centre; in such cases the doors are lowered to the bottom, thus assisting to reheat the heads. Oxidizing conditions are maintained by thin fires and a slight excess of air passing in at the doors, while reducing conditions are produced by the opposite—that is, by a somewhat thicker fuel bed, with excess air reduced by stack dampering to a point where the draft is but slightly in excess of neutral. Little difficulty is experienced in producing the desired condition.

Economy From the Use of Forced Draft

From the data and figures collected during the past year the following deduction has been made: That the principal saving to be derived from force draft is of a two-fold nature—first, by producing a means for burning a grade of fuel which, frequently due to physical conditions, must be passed over or discarded by the use of ordinary draft; second, kiln economy—that is, the burning time can be so shortened that a gain of 10 per cent. or more is obtainable on the annual kiln turnover.

Discussing first the fuel, the fact that screenings or low-priced fuel can be used with forced draft does not necessarily mean that it is in all cases economy to do so. Other conditions being equal, that grade of fuel which will give the greatest number of heat units per dollar is the one that will prove most economical, even though there may be a considerable difference in the price per ton. It not infrequently happens—during the present trying times at least—that one cannot at all times have a choice of fuel, but must take any that can be found—lump coal, mine run, screenings, slack, coal with fourteen thousand B.T.U.'s and others with barely half as much, as well as no coal at all. The problem of meeting these conditions is most discouraging, especially with ordinary grates and natural draft, but with forced draft such conditions are more easily met, owing to the fact that any of the various grades can be used, which materially extends the field from which to obtain a supply. Usually it will be found that screenings or slack can be obtained much more readily and regularly than lump coal. This quite naturally increases the chances for a steady run or output to those plants equipped for their use. During the past year at Crawfordsville it has been necessary, in order to keep going, to burn such grades as forked lump coal, mine run, screenings, and very fine slack, though, quite naturally, with varying degrees of satisfaction.

Soft Lignite Successfully Used

Another illustration of the adaptability of forced draft to various grades of fuel, and which, in a measure, verifies an earlier statement in reference to the use of lignites or brown coals, has recently been received from Mr. E. H. Crandell, of Calgary, Alta., who uses forced draft in the burning of dry pressed face brick. Ordinarily a pea coal from the anthracite mines near Banff is used on the Crandell plant, but as during the past summer the usual supply was cut off, it became necessary to use a nearby soft lignite coal. In Mr. Crandell's communication he states that the results were highly satisfactory, the only difference being that a slightly increased amount had to be used. This would be quite natural to expect on account of the difference in available heat units of the two fuels.

Kiln Economy

The annual capacity of a kiln is dependent upon two factors or conditions—first, the amount of ware which can be placed in it; second, the number of times it can be burned per year.

The former is a fixed amount, but the latter, or annual turnover, can be altered within certain limits, established, first, by the material to be burned, and, second, by the rate of fuel combustion. Thus, if the shortest possible burning time of a clay is known, and means are provided to attain that rate, then any kiln can be made to give the greatest return on the money invested. The first point to be established is, at what rate can a given clay be burned. Mr. A, for instance, takes ten days, Mr. B eight days, and Mr. C another period. This, however, does not necessarily mean that a shorter period could not be made to give just as satisfactory results in each case. This brings to my mind an article by Mr. Greaves-Walker, appearing in "Brick and Clay Record," in which he made the statement that he was certain that fully 90 per cent. of the shales and clays of this continent could be burned in six days or less. From actual tests on a wide range of clay product materials, from both United States and Canada, I can affirm the above statement. One of the most remarkable cases to come within my work was that of an alluvial clay manufactured into roofing tiles; the kilns were rectangular, 18 x 45 feet inside measurement. The average burning time by means of oil was only 32 hours from time of lighting to finish, giving a perfectly burned tile in that time.

Increase in Annual Turnover

At Crawfordsville 10-pound paving blocks have been burned to cone 2 successfully in five and one-half and six days during the past season. It is believed that, with kilns properly balanced for draft, this rate can be maintained regularly. From past experience it would be difficult, if not impossible, to obtain this rate under natural draft conditions, eight and nine days being nearer to the average time. A few calculations will reveal the fact that a saving of two days' burning time amounts to approximately 11 per cent. gain in the working time of a kiln; in other words, it increases the annual turnover per kiln about two and one-half burns. This increase, or gain, can be taken advantage of by a larger capacity, or as a reduction in the number of kilns to be built at the start. This saving of burning time, or kiln economy, has a very marked effect on the burning cost, inasmuch as it makes a large reduction in the labor and the amount of fuel consumed. This is shown by the following figures, which have, for the greater part, been derived from carefully-kept daily records of the Standard Brick Company, Crawfordsville, Ind., and represent actual conditions:

Power cost per 1,000 builders, $0.0547; labor cost per hour per kiln of 60,000, $0.1500; coal per hour per kiln of 60,000, 357 pounds; cost of coal per hour per kiln of 60,000, $0.4750; hours saved by forced over natural draft, 48 average. Resultant economy: Coal for 48 hours, at $0.475, $2,303; 48 hours' labor, at $0.15, $7.20; total, $30.23; less power for 60,000 brick, $3.28; net saving per kiln, $26.95; or a saving per 1,000 builders of $0.45.

Conclusions

Summing up briefly the pros and cons of forced draft we find them to be about as follows:

(a) Advantages:

1. The permissible use of a wide range of coals, including the lignite.
2. Provides a means for high kiln efficiency.
3. Economy of fuel by shortening the burning time.
4. Economy of labor for the same reason.
5. Favorable water-smoking conditions.
6. Very little affected by weather conditions.
7. A very low furnace upkeep.

(b) Disadvantages:

1. Original cost somewhat in excess of natural draft.
2. A continual operating expense for power.
3. Requires close attention from the burners; this, however, should prove beneficial.
4. Subject to delays from accidental causes.

In conclusion, it is the writer's belief that there are many plants of moderate size where the use of forced draft would prove of great assistance, in the lowering of burning costs, through the use of low-grade fuels and shorter burns.

War Conditions Augment Motor Traffic

Measures for Expeditious and Economical Improvement of Highways Under Present Circumstances—The Development of Motor Truck Transportation

WAR conditions have more or less affected highway construction, as indeed all engineering and contracting work. The high price of labor and material and a feeling prevalent to a certain extent that highways are luxuries have combined to curtail the improvement of roads throughout the country. There has been, however, a rapid development of motor truck traffic on country highways, especially in the United States, instigated almost entirely by war conditions. The development of motor truck traffic and its effect were considered in a paper read recently at the American Association for the Advancement of Science convention, by Arthur H. Blanchard, consulting highway engineer, New York. This paper, extracts of which are reprinted herewith, considers the improvement of highways to meet this new condition and the details of construction that will suit war-time needs. Most of the points are applied to conditions in the United States.

Available cost and operation records and the opinions of users of motor trucks on long hauls leads to the conclusion that, granted good roads and efficient management, the transportation of industrial and agricultural products on hauls of 50 to 75 miles is economical under peace as well as war conditions. Recent evidence in support of this contention is furnished by statements of motor truck companies using country highways. Motor truck transportation for distances in excess of 75 miles will be found to be economical under certain conditions. Under war conditions excessive long haul transportation will be developed to a large extent.

Incident to the general development noted is the progressive establishment of express motor truck transportation companies, several of the pioneers being in operation in the State of New York four or five years ago. One of the most widely advertised companies is operated by the Goodyear Tire and Rubber Company, between Akron, Ohio, and Boston, the round trip of 1,510 miles being made in less than one week. Another prominent company, the Beam-Fletcher Corporation, operates a daily motor truck service between Philadelphia and New York, and guarantees deliveries in New York by noon of goods received not later than 5 p.m. on the preceding day in Philadelphia.

Feeders to Railroads

Another special field in which motor truck transportation is developing is found in areas surrounding railroad centres. Under peace and war conditions it is economical, granted good cross-country highways and efficient management of motor truck companies, to transport freight consigned to a town on one railway line entering the terminus from a town located on another radiating railroad. Under war conditions, at least, the railroads will welcome such development of motor truck transportation, as freight cars are thus saved for long hauls and the congestions of freight yards relieved.

Under war conditions railroad freight haulage by motor trucks over highways paralleling railways may, in some cases, become mandatory in order to relieve the congestion of terminals and increase the monthly ton mileage of freight cars. By increasing unloading facilities at railroad stations on lines entering a city many classes of freight consigned to the terminus could be transferred to motor trucks and thus delivered to the consignees.

If the food problem is partially solved by the establishment of city public markets supplied by motor trucks direct from farms, motor truck traffic will increase enormously on many highways entering cities.

Highway Improvement Under War Conditions

It is evident, therefore, that transportation by motor trucks will rapidly develop under war conditions, and that highways of inter and intra-state transportation systems must be improved if agricultural, industrial, and commercial activities necessary for the successful conduct of the war are to be efficiently maintained.

Granted the economic necessity of a vigorous highway improvement campaign, a program must be outlined under which the improvement of many highways may be carried on expeditiously and at a minimum cost under war conditions. Excellent educational and productive work has already been started by government bodies, local highway organizations, and the technical and daily press. The following suggestions do not constitute a complete program of procedure, but are presented for consideration and discussion as factors in constructing and maintaining highways under war conditions.

It is evident that it will be necessary for states, counties, towns, and contractors to use motor trucks under all practicable conditions for the transportation of highway materials and machinery. In order that the utilization of motor trucks on country highways may be economical and efficient it is highly desirable that some agency should acquire all reliable data pertaining to haulage by motor trucks on country highways under varying conditions and give wide publication to all data of value to users of motor trucks.

Granted ideal improvement of highways for use by motor trucks, efficient operation will be impracticable if traffic regulations are not based on sound economic principles. Furthermore, the economic use by motor trucks of trunk highways will be difficult if each state continues to enforce laws radically different from adjoining states. For example, the Beam-Fletcher Corporation of Philadelphia, which operates a daily motor truck express service between Philadelphia and New York, states that "New Jersey's new motor vehicle law reducing speed of trucks to ten miles per hour, with sealed governor, will, if enforced, make it impracticable for us to continue operation east of Pennsylvania after January 1."

Speed Limit Not Too Much Restricted

Investigations made in the State of New York showed that the average speed of motor trucks carrying a load of one ton was about 19½ miles; carrying from two to five tons, about 17½ to 14 miles respectively; and carrying fifteen tons, 10 miles per hour. The investigation also showed that 65 per cent. of the motor trucks using highways outside of cities carried loads varying from two to five tons. It is evident, based upon the above statistics, that a maximum speed regulation of ten miles per hour would mean a material reduction in the present average speed, and, in most cases, the impracticability of using motor trucks economically for transportation purposes on long hauls.

Not until the effects of the normal operation of motor trucks on efficiently improved roadways have been established should maximum speeds of less than twenty miles per hour for trucks carrying loads up to three tons and fifteen miles for trucks carrying over three tons be incorporated in traffic regulations. Neither should unwarranted restrictions be imposed relative to over all dimensions of motor trucks and the use of one, two, or three trailers.

Contracts and specifications must be simplified, otherwise it will not be practicable to secure bids from responsible contractors. It would be advisable that there should be adopted, as far as practicable, simple, uniform, general requirements of contracts and specifications which would reduce to a minimum the burdens now placed on contractors, retaining only such stipulations as are necessary to ensure honest work under competent supervision. Special attention should be given to the following subjects: The elimination of maximum prices in bid sheets; the insertion of definite requirements covering materials so that contractors may determine on the source of supply before bids are submitted; elimination, as far as practicable, of the use of the objectionable phrase, "to the satisfaction of the engineer"; elimination of clauses which make contractors assume the financial loss caused by rectification of mistakes in designs and specifications.

Making use of local materials for the construction of highways has always been advocated. In the consideration of methods of highway improvement special attention should be paid to devising suitable methods which will require minimum tonnage and bulk transportation of highway materials. Maximum use must be made of deposits of sand, gravel, and rock. This necessity will lead to the development of many local deposits from which the materials may be transported by motor trucks.

Labor Under War Conditions

Methods should be adopted utilizing to the minimum common and skilled labor. In conjunction with this recommendation its correlation should be considered, namely, the maximum use of labor-saving machinery in all methods of construction and maintenance.

Convict labor should be used to the maximum extent of the availability of such labor. The mooted questions of economical use of convict labor and competition with organized labor are eliminated, due to war conditions. Able-bodied prisoners of war, not being utilized in foreign countries, might be transferred to this country and assigned by the government, under military supervision, to highway work under state departments.

The development of motor travel and motor truck transportation has vividly drawn attention to the relative values of different classes of highways to the nation, state, county, and urban districts. Public opinion is slowly but surely tending towards the conclusion, held by many individuals and associations, that inter-state trunk highways should be constructed and maintained by the national government. Under war conditions, such action by the government is a military and public welfare necessity. It is possible, by this method, to have the vital trunk highways of the nation designed, constructed, maintained, and regulated so that their utilization for motor truck transportation under war conditions will be economically practicable.

Low Compensation Rate for Ontario Clay Products Industries

DESCRIBING the operation of the Ontario Workmen's Compensation Act, Mr. Samuel Price, chairman of the Workmen's Compensation Board, stated before the Canadian National Clay Products Association that the rate applying to the clay products industry in Ontario was much less than in any of the states where a system of state insurance for compensation is in vogue. For the manufacture of clay products the original rate in 1915 was fixed at 90 cents per $100 of pay-roll. In 1916 this was reduced to 60 cents. At the end of 1916 it was found that experience for the clay product manufacturers was not as good as had been expected, and the rate was raised retroactively to 90 cents. A 90-cent rate was also fixed for 1917. It was hoped that this rate might still be sufficient for 1918, but this cannot be definitely settled until the experience for the past year has been fully tabulated.

Comparing this 90-cent rate with the rates last year it is found that Ohio charges $1.45; Michigan, $2.06; New York, $2.91; Pennsylvania, $1.31; Illinois, $2.37; Wisconsin, $2.32; Indiana, $2.25; Kentucky, $1.97; Colorado, $1.53; Washington, $1.50; California, $2.39.

The way to keep the rate low, according to Mr. Price, was to avoid accidents. This will now be a matter of special individual concern to each employer, inasmuch as under the system of merit-rating to be adopted, the employer having a bad accident experience will pay a higher rate of assessment than the employer whose accident experience is good. The adjustment will be made after the accident experience of each employer has been ascertained.

Manitoba Steel & Iron Co. Organized

THE organization meeting of the Manitoba Steel and Iron Company, Ltd., was held in the city of Winnipeg on February 8, and the following board of directors was elected for the ensuing year: T. R. Deacon, H. B. Lyall, Sir Augustus Nanton, George F. Galt, G. W. Allan, K.C., M.P., Sir Douglas Cameron, Charles Pope, Capt. William Robinson, and W. H. Cross. At a subsequent meeting of the directors the officers were elected as follows: T. R. Deacon, president; H. B. Lyall, vice-president; Walter Stuart, secretary.

The company has been incorporated with a Dominion charter, with an authorized capital of $500,000, to take over the merchant end of the business of the Manitoba Bridge and Iron Works, which has grown to considerable dimensions. The new company is strongly financed, and will carry on a general merchant business in heavy steel goods, such as structural steel, plates and sheets, bar iron and steel, boiler tubes, rivets, bolts, railway supplies, mining equipment, heavy forging billets, and stock for shipbuilding. An entire block of land, with a suitable warehouse, has been secured on Logan Avenue, with railway siding facilities, and business will be commenced on March 1. The business will be carried on along lines similar to the large steel and iron merchant businesses of the United States, contracts for large tonnages being made at one time with the rolling mills. Authority is also given under the charter to build and operate rolling mills and blast furnaces.

The Manitoba Bridge and Iron Works purpose confining their operations more to the purely manufacturing side of the business, for which this change will afford them more needed room on their present site. The latter company is also applying for a Dominion charter, with an authorized capital of $1,000,000.

Difficulties in Clay Plant Operation

SPEAKING before the Canadian National Clay Products Association on difficulties in the way of successfully operating clay plants, Dr. L. L. Plant, Georgetown, Ont., stated that trouble could often be traced to the clay bank or shale pit. He instances a plant that had defied several ceramic engineers. It had a capacity of 50 tons of fireproofing and 150,000 wire-cuts per day, and was equipped with round, down-draft kilns and waste heat drier. The clay was nice to handle in the making and the drying, but in the process of burning it would burn itself and have to be drawn out with sledge-hammers and crowbars in two or three hundred pound chunks. It was simply a molten mass. The changes in the burners, to which the trouble was at first attributed, did not improve conditions. The trouble was traced to the clay pit, the reason being that the material contained a very large amount of sulphur and vegetable matter, which burned itself when it became red hot. As a remedy, about 40 per cent. of refractory clay from another part of the bank was added to the impure material, with the result that a clean, cherry-red brick and fireproofing of perfect dimensions and excellent ring were produced.

Kiln Operation Is Important

The operation of the kiln is claimed by Dr. Plant to be the most important matter in clay-working operations. He does not define an ideal kiln for all wares, but recommends the rectangular, down-draft kiln as the best for brick. A great many kilns that turn out bad burns time after time can be made to give good results after altering the bottoms, making sure that the system of draft in the bottom is such that the kiln draws well at all points. The brick must also be set open enough to secure a good draft. The stack is a very important part of the kiln, and is often not given sufficient consideration. The stack must be of the proper height and the flue of the right diameter for the number of kilns it has to draw.

In speaking of clay-working machinery, Dr. Plant emphasizes the need of proper location and relationship with other machines. Many brick men, according to him, crowd their factories with unnecessary machinery, and, instead of increasing their output, are thereby adding a virtual loss.

The Architect's Place in Railway Work

The Author Deplores Lack of Proper Architecture in Design of Railway Stations and Scores Standardization Methods

SPEAKING before the Canadian Railway Club on "Architecture and Building as Applied to Railway Work," Mr. C. Gordon Mitchell, architect, representing the Canadian Northern Railway Company, Montreal, outlined the work of the architect in designing railway terminal and passenger stations. He pointed out how common improper designs are, due to non-appreciation of the conditions railway terminals have to fulfill. A large part of his paper is devoted to a vigorous condemnation of standardization methods, as practised by some of the railway companies in regard to their stations. His views were criticized by many taking part in the discussion which followed the presentation of the paper. The following matter is condensed from Mr. Mitchell's paper;

Competition Ensures Better Stations

The retrospective view is short to the time when there was not a comfortable, well-designed railroad station on the continent of America, and the principal reason of this condition is not far to seek, viz., lack of competition. If there be any doubt on this subject, I would ask you to make a comparison between rival railway stations in most cities and the same companies' stations where there is no competition. Look at some of the older railroad passenger stations and, tell me, have they one redeeming quality? Do they in any way fulfill the objects for which they were built? You answer, yes, and I agree; but I maintain they fall very far short of fulfilling what might have been accomplished had they been properly designed. Now, if this arises from ignorance of the case it might be excused, but it cannot be applied to railroad companies, for you will find that where there is keen competition the passenger station has generally been designed by a competent architect, collaborating with the officials of different departments, so as to include all requisites necessary to the comfort of the public, efficiency of the employees, and good administration, thereby contributing to the success of the railroad company. If this be the case at competitive points, does it appear good judgment, sound logic, or wise business that at all others anything is good enough which will protect the baggage, express, and passengers from the storm. Will an hour spent in a poorly-lighted, badly-ventilated, and insufficiently heated waiting-room tend to make the public speak highly of any public service? The public are the patrons, and it is they who should be considered. Therefore, I contend, that much care and study should be devoted to the designing and building of even the smallest station, so that the very best results may be obtained from the money at the disposal of the architect. I say architect advisedly, because I am convinced that no other profession is capable of designing a building which will fulfill all the conditions of cost, requirements, etc., and then only if he has had good judgment and experience combined.

Build Soundly, Not Gaudily

This is a commercial age, and cost, therefore, looms largely on the horizon of every undertaking, and it is by no means absent in building enterprises. Inferior designers, knowing their inefficiency, will often attempt to excuse the shortcomings in their work on the ground of cost. No weaker excuse could be attempted.

Not many railroad architects suffer from the burden of having too much money to spend on their buildings, and he is wise who knows that the foundations are well designed before thinking of decoration; but, unfortunately, the public demand show at the expense of construction. The true spirit of architecture is sound construction, and, if the proportions are well designed, the results will be pleasing, in spite of the lack of decoration. Are we to expect good proportion from a designer who is ignorant of the fine orders of architecture, oftentimes totally so? The intimate knowledge of these is the cradle of all good proportion, and to obtain this knowledge requires not only inborn aptitude, but years of study. If, then, my statements are correct, it is little wonder we have so many monstrosities in railway buildings. Where does the blame lie for so pitiable a state of affairs? It is not the chief engineer of the road who is responsible, even if the work of designing the building falls directly to his department. I suspect the finance department is generally the culprit, and, "to cut down expense," the work of designing important buildings is often delegated to one of the junior engineers, the prevailing idea being that anyone can design a building. The most simple and inexpensive building may be made adequate and beautiful in its simplicity if designed by a competent designer and carried into effect by a properly qualified builder, the two collaborating in their work.

As to cost, the sure method of increasing the eventual capital cost is to employ unqualified designers, for in a very short period of time the maintenance of badly-designed buildings will eat up very much more than the original outlay of paying for good design. If this is not the case, why, let me ask you. do the shrewdest business men throughout the world employ architects to design and supervise the erection of their buildings? Some railroads have adopted a middle course—that of employing architectural draughtsmen, generally the cheapest men on the market. Here, again, I question the wisdom, and. from personal experience, I have found that the cheap assistants are dear at any price.

Standardization Deprecated

I would now call your attention to standardizing buildings. Standardization at first glance appears very attractive from the economical viewpoint, but does it bear close scrutiny? Firstly, standardizing suggests similar conditions and demands a unit system of designing. Can a unit system be applied successfully throughout? I am of the opinion that it can only be applied partially, even to what might appear stereotyped buildings of the commercial class—e. g., workshops, warehouses, and freight sheds.

The chief objections, in my opinion, to standardized buildings are as follows: In every case where a building is necessary the conditions are different. In attempting to make the standard suit the varying conditions it will mostly be found that so many variations occur that little of the standard plan remains, and possibly better results will be obtained by ignoring it entirely. For example, will the requirements of a roundhouse at Prince Rupert be exactly similar to those at, say, Quebec, presuming that the engineering work executed at each point is of the same character? If this be the case, can a standard roundhouse be erected at every requisite point from Halifax to the Pacific Coast, and give full satisfaction in each case by merely reducing or adding to the number of units necessary? The climatic conditions differ all the way through, and this fact alone will, to some extent, modify the details of a standard plan. The best materials to use for construction and their cost must differ in different localities, so that in some cases it might be wise to use stone, in others brick or reinforced concrete, or any two or perhaps all three of these materials. If this be true, we shall want not one, but perhaps three standard roundhouse plans to begin with, and, then, how about the units? Can a standard be adopted the unit of which can either accommodate a hundred workmen or, by being doubled, accommodate two hundred and still bear equal relation in each case? I should question it. I do not argue against a typical layout of plans for certain kinds of buildings. The conditions being similar, the general layout of a plan may be typical with successful results, but so soon as the conditions change to any considerable extent I maintain that a standardized building plan will have to be changed. As regards the changed conditions, these can only be fully appreciated and provided for by trained men.

Conditions Differ Widely

Wherein lies the great advantage of standardization relative to building? If it is merely to save the cost of designing a new or, it may be, typical plan to suit all the new conditions, then it appears to me a fallacy. In the case of passenger stations, where the amount and kind of business done, the size, position, shape, and levels of the ground differ in each case, a general type of station may, with good results, be adopted, but I cannot reconcile a standard plan with satisfactory results.? Standardization may be best applied to things that are required by the hundreds to fulfill the exactly same requirements and conditions. Manufacturing by hundreds or thousands is much less costly per unit than producing by units as when required, but the cases are not parallel; in buildings the case is rather reversed. We build to suit the exact necessities of a different requirement each time, and I may add that, after thirty years' experience in active architecture and building, I have never yet been able to use the same or similar types for the same or similar purposes and governed by similar conditions, but always with differences sufficient to call for a new plan. I have only once worked as an architect's assistant in an office where standard drawings were used, and I am positive my employer did about the worst work I have ever touched. His idea was to save cost in production of drawings, but the time spent in trying to adapt these standards to the new work was a very questionable piece of financing, a very degrading form of architectural practice, and resolved itself into a continual stream of new assistants through the office, until he, at last, reached the class of man who had no interest in his profession beyond the pay cheque at the end of the month.

Standardization of building materials has often been attempted, but cannot be strictly adhered to. Let us take one example which is very popular with large companies, viz., standard paint. I think probably more money is made by manufacturers out of their standardized paints than any other they produce.

Perhaps no building material is more faked than paint. To the average person all paint is just "paint." It is a commodity very largely advertised. Advertising is expensive, but it pays when the scale is large enough, and, naturally, it is the purchaser of the largely-advertised paint who does the paying. He pays in the quality of the material because he is ignorant of what he is buying. Companies, on the other hand, often have analysis of the standard paint they use, and upon this analysis the supply contract is based. These contracts get renewed from time to time; the purchasing agent has long forgotten the analysis exists, and, in many cases, the manufacturer also. It would be well in all cases where standard paints are used to have a periodical analysis made, so as to be sure the manufacturer or some of his employees have not taken it upon themselves to slightly modify the standard.

Object to Author's Opinions

During the discussion which followed, the views of Mr. Mitchell were criticized by some speakers, who held that his ideas were too Utopian. Exception was taken to some of his remarks regarding standardization, the opinion generally being in favor of the standardization of buildings wherever possible. It was pointed out that buildings of this class were specially adapted for small towns of a similar character, and it was stated that many of the C.P.R. stations were constructed from standardized plans. In the case of terminals it was a different proposition, and it was imperative to employ architects to design suitable buildings. The question of cost, too, was often a consideration and buildings had to be erected within a certain sum. It had been stated that the only proper place for the use of reinforced concrete was underground, and that it was impossible to embellish reinforced concrete structures. The reply to this was that there were many instances where concrete buildings had been to a certain extent embellished, and that masonry entailed considerable cost in upkeep by reason of the necessity of being re-pointed.

The bill introduced by Mr. Adrien Beaudry into the Quebec Legislature affecting the status of civil engineers has been passed, but with an amendment safeguarding the interests of some engineers who are not members of any society in the province. This amendment is to the effect that the bill will not apply to engineers who, prior to December 31, 1917, were corporate members of "any" recognized society of civil engineers and who had been practising their profession in the province for four consecutive years prior to Demember 31, 1917.

The Columbus Chain Company, with factories at Columbus, Ohio, and Lebanon, Pa., and the MacKinnon Chain Company, with factories at Buffalo, N.Y., and St. Catharines, Ont., have united under the name, "The Columbus-MacKinnon Chain Company." The new company have formed their Canadian organization, known as the MacKinnon-Columbus Chain Co., Ltd., with general offices at St. Catharines. The new company will offer to the trade a full line of electric welded chain and fire welded chain manufactured at their Canadian factory.

Public Works of Manitoba

Recent Report Details Progress on Public Buildings and Highway Work

THE annual report of the Manitoba Department of Public Works was recently presented to the legislature by Hon. George A. Grierson, Minister of Public Works. Besides a comprehensive review of the work of the department by the deputy minister, S. C. Oxton, it contains the full reports of sixteen sub-departments. The following matter, taken from the report, deals more particularly with the building and highway activities of the department:

New Parliament Buildings

The report states that the exterior stone work of the new capitol has been brought to general roof level and both wings closed in. The interior stone work has progressed favorably, and the concrete in the dome section brought to general roof level and temporarily closed for heating purposes, so that pouring of concrete can proceed this winter to bring the structure to the level to receive the steel in the early spring. Half the basement, three whole floors in the northeast wing, and one in the northwest wing are occupied at present.

The only thing remaining to be done on the new law courts is the treatment of the entrance and grounds to be taken up this spring. The central power-house is now supplying steam for the whole group of government buildings, including the university buildings, and contractors' heat for the new parliament buildings other than the portion in use. The tunnel is in full operation. There is still considerable work to be done in the central power-house in connection with electrical service and equipment of various kinds. Motor generators are being installed, and it is proposed to take all the power required for light and power purposes in the buildings at high tension and transform and distribute it either in alternating or direct current for light and power purposes at various voltages as required. The government is purchasing the current at ½ cent per kilowat hour from the city, but as soon as this installation is completed it expects to make a big saving by doing its own transforming and distributing. The power-house and its equipment, when complete, will, it is stated, be the most modern installation of its kind in the province, and will be used also for demonstration and educational purposes. Operating engineers from other plants are invited to visit it.

Other New Buildings

The new court house and jail at Dauphin and the community building at The Pas have been completed, and are now occupied. Both were designed by local architects. The government is also sharing half the cost of the new community building at Emerson. Attention is drawn to the work of the three different architects of these buildings. The remodelling of the old law courts for the university, of buildings at the school for the deaf (which was, however, taken over by the Military Hospitals Commission), and of buildings at the agriculcural college now being used for the school for the deaf, are referred to in detail.

The deputy minister states that considerable renovations are going on at the Brandon asylum plant, but this will require to be enlarged or replaced by a modern plant if there are considerable extensions to the institution. He recommends that the institution do its own lighting, and that boilers be installed with automatic stokers for lignite coal. This class of local coal is now being used. Improvements have been made at the institutions at Portage la Prairie in the operating plants eliminating the gas danger and cutting down the fuel expenditure.

Necessary improvements in various institution buildings are explained at length in the report, particularly for the enlargement of the asylum at Brandon and the provision of a reliable water supply. Necessary alterations and extensions of the provincial institutions at Portage la Prairie are also explained in detail, and the need for a new permanent school for the deaf. The cottage unit plan is suggested.

591 Miles of Road Approved in 1917

The report of A. McGillivray, highway commissioner, is a voluminous review of the activities of this department of public works. It deals mainly with the good roads program, and, exclusive of the expenditures under the "Aid to Municipalities," shows that $466,946.26 was spent on roads and bridges under the Good Roads Act, the government contributing $220,996.55 of this. There were 315.5 miles of gravel and 275.75 miles of earth roads approved last year, or 591 miles of road in all. The total of all roads approved under this act to date is 1,922.20 miles, of which 1,154 miles are gravel and 23.25 miles pavement. The figures show 1917 to have been a banner year. The report contains exact and detailed figures of cost as to roads and bridges, which will be of much interest to municipalities and engineers.

The report of the acting chief engineer of work done directly under the appropriation of "Aid to Municipalities" shows extensive surveys and work in the various drainage districts, and considerable assistance given to municipalities in engineering advice.

The land benefited in the 20 drainage districts by the 2,471 miles of drainage constructed to date is said to be 2,087,240 acres. The statistics of expenditures under the heading of "aid to municipalities" last year are not given, as they appear in detail in public accounts.

The well-drilling superintendent reports 17 machines kept busy, with 211 water wells to the credit, 5 dry wells for drainage purposes, and 2 test wells for gas. The water-finding instrument has located some good wells.

The report of F. W. Simon, the architect of the new capitol, deals in detail with the work during the year, and the progress on the various contracts, which were delayed by labor conditions and United States war regulations affecting the steel, but upon which generally satisfactory progress was made.

The following have been appointed members of the newly formed Nova Scotia Provincial Highways Board: Mr. W. G. Clarke, of Bear River, chairman; Col. T. Cantley, and Messrs. Percy Black, Jas. K. Kelleher, and Walter Crowe.

The annual convention of the Ontario Good Roads Association will be held in Toronto, at the York County Buildings, during the three days, February 27, February 28, and March 1.

Locomotive Cranes as Pile Drivers

FORMERLY foundation piles were generally driven by a hammer operated in the leads of a tall and cumbersome tower usually mounted on a large, heavy platform on which a hoisting engine and steam boiler were installed. For land service the tower and platform were, and still are, very heavy and unwieldly and extremely difficult to move a considerable distance from place to place, generally requiring to be dismembered, transported in sections, and re-erected, operations involving considerable time and expense. When in operation they were usually mounted on double sets of rollers and laboriously shifted longitudinally and transversely for every pile driven. Exceptions to this rule were the costly and elaborate turntable pile drivers, some special machines designed and constructed for large amounts of service on a particular job, and the railroad pile drivers mounted on flat cars and provided with cantilever supports for collapsible towers that could be lowered to give clearance for transportation along the line.

Floating pile drivers possess considerable advantage in the facility with which the barges on which they are mounted can be shifted for driving successive piles close together, and are well adapted for driving large numbers of piles in piers, bulkheads, breakwaters, foundations, and other structures built in sheltered positions in water of a minimum depth of 3 or 4 feet, sufficient to float the machines. Such machines cannot, however, circulate in unnavigable streams or be operated or safely navigated in very rough water so that they are usually closely confined as regards locality.

In all cases the tower machines lack flexibility and rapidity of operation, are expensive in use, require a number of men to manipulate them, and are of little or no service for any purpose other than driving piles under the conditions for which they are designed.

Since the introduction of steam hammers it has been found possible to use them in leads suspended from a derrick boom and even without leads when handled by a tackle operated from a derrick boom, an A-frame, traveler, or other suitable support. When handled by a derrick or A-frame they can generally be used only within a limited radius without the installation of another derrick or the delay and expense of taking down, moving, and setting up again the original derrick.

These conditions have made the driving of heavy piles, especially in small numbers, a difficult and costly operation involving a disproportionate expense for the installation and removal of the plant. The driving of a large number of piles also involves considerable time and expense in the preliminary work of constructing, transferring, or installing the plant unless it chances to be already available at the exact locality required.

In the December "Contracting" there is an article descriptive of the application of locomotive cranes to pile driving purposes, the hammer being suspended from the regular boom either with or without leads. Such an arrangement is economical, the economy being increased by the ability of the machine to move and serve itself. Excerpts from this article follow:

Most of the advantages of a floating machine, a land tower, a railroad pile driver, and a turntable pile driver are combined in the use of a locomotive crane equipped with adjustable leads for driving long and heavy piles. The crane is fundamentally a locomotive derrick with a working area having a width twice the length of its boom and a length limited only by the installation of standard or special-gage track on which the crane moves. The fact that it is much lighter than the old-fashioned, massive pile driver tower enables such a track to be quickly and cheaply constructed and to be carried in many places where the bearing value of the soil or the strength of the structure would not readily sustain the heavy tower.

Used as a derrick, the locomotive crane can in many cases do very economical and efficient work in unloading materials, installing plants, erecting structures, and the like, and can also be rigged wtih a drag line, scraper, or excavating bucket to dig foundation pits, excavate cuts and trenches, or make fills and embankments. Besides this it can act as a locomotive or switching engine and can carry materials suspended from its boom or can haul trains or shift cars. It can be installed even on the deck of a barge and perform the functions of a marine derrick, or lighter, dredge, or it can sometimes be installed on the decks of a train of flat cars running back and forth to unload them or do other service.

Locomotive Cranes with Pile Driver Leads

Besides doing much auxiliary work of a nature that is likely to be important on very many occasions where foundation piles are to be driven, the regular standard locomotive crane may be provided at a moderate additional cost with an entirely separate and independent attachment, quickly connected to its boom, that immediately provides rigid leads in which either a steam hammer or a drop hammer can be installed and the whole made adjustable for driving long piles in perpendicular or inclined positions at any point within a long radius from the stationary machine and, by moving the machine under its own locomotive gear, at any point on either side of the track within the boom reach. In such a case the drop hammer can be handled by the regular boom hoisting tackle or the same tackle can handle the steam hammer in the leads and the hammer can be supplied with steam from the regular boiler operating the locomotive crane. An additional whip line can easily be rigged enabling the locomotive crane to handle the piles and place them in the leads with the important advantage of being able to swing around and pick them up from the rear or even to travel back and get them when necessary.

Such a tool possesses great flexibility and is almost universally applicable for a wide variety of standard operations making it available in one shape or another for many of the most important operations that a general contractor encounters in heavy construction work and eliminating the initial cost, installation, and transportation of a number of separate machines that would be required to do the same work. It greatly expedites the driving of small groups of piles in different localities and eliminates the great excess of cost otherwise involved in driving detached piles.

Collapsible, Adjustable Leads

Different types of locomotive cranes are equipped with specially developed pile driver leads suited to the particular features of the different machines and to different classes of service, adapted for light or heavy work.

A collapsible and adjustable pile driver attachment for a locomotive crane has been used on the Browning locomotive crane in accordance with plans developed by J. E. Houston, of the Browning Co., and H. A. Loyd, Division Superintendent of the Erie Railroad Co., which provides a tool for special maintenance of way operations. It is particularly intended to serve under conditions where it is necessary for the pile driving apparatus to be disconnected or lowered so that it can pass through tunnels, under bridges, or be quickly gotten out of the way when operating on the main line. This machine has structural steel leads about 30 per cent. longer than the standard crane boom that are pivoted to the point of the latter by a connection on the leads at a point a little above their center of gravity. In working position the lower end of the leads is braced to the foot of the boom by a horizontal strut maintaining them in a vertical plane. The leads are suspended from a horizontal pin that permits them to be tilted at any required angle in the vertical plane transverse to the plane of the circumference of the boom radius. The crane revolves on its turntable through a complete circle, hoists the piles to its leads, and can operate the steam hammer from the boiler installed for the service of the locomotive crane.

Collapsible Leads

The side elevation of this pile driver attachment ready for service shows two slack lines from the center of the boom to the outer ends of the horizontal struts, these lead to an operating drum which can wind them up, revolving the struts around the pivots at the rear ends to collapse the boom and leads which can be lowered into the horizontal position over an idler car. In this position the leads can be disconnected from the boom or remain in position for short hauls.

This crane is equipped with an extra large boiler and a 10½-inch cross compound compressor and auxiliary air reservoir providing for the use of pneumatic tools in bridge construction. It has a lifting power of 25 tons and is designed to handle an 8,000-lb. steam hammer. It will drive piles 50 ft. long 22 ft. in advance of the front wheels of the crane. The leads can be fitted to use any make of steam or drop hammer preferred and are provided with automatic locks and supports to hold them in either working or folded position. The leads can be quickly attached or detached and in no way interfere with the use of the machine as a straight locomotive crane.

Locomotive Crane with Vertical Leads

Very efficient rapid service on straight work such as the construction of pile trestles may be attained by simple and inexpensive vertical leads suspended from the end of the crane boom and merely spaced in position by light horizontal struts attached to the lower end and fastened to the track in advance of the crane.

A 30-ton, eight-wheel standard-gauge steam operated locomotive crane built by the Orton & Steinbrenner Company, for the Chicago Outer Belt Line was equipped with a 50-ft. boom, 2-yard clamshell bucket, magneto and generating set for general purposes. For pile driving the boom was removed and replaced by a steel cantilever truss equipped with vertical steel pile driver leads pivoted to the forward extremity of the truss and braced in position by light steel struts inclined 45 degs. to the vertical. This provided a rigid machine of long reach that could be rapidly operated on heavy construction. The leads could be collapsed to horizontal position to lie on top of the truss, providing clearance for transportation along the line. Both leads and truss could be quickly and easily disconnected and removed and the regular boom connected up in their place.

Locomotive Crane with Tilting Simple Leads

A Browning crane used by the Gulf, Florida & Alabama Railway Company was provided with light steel leads directly pivoted to the end of the boom without the intermediate link used in other types for collapsing the leads. The lower ends of the leads were secured by connections to the outer end of a pivoted, horizontal platform suspended from the boom and designed to be revolved upwards against the boom if necessary for clearance purposes. The leads were connected to this platform through a moon beam which consisted of a segmental angle rigidly attached to the platform and pierced with holes through the vertical flange permitting the leads to be bolted to it in inclined positions corresponding to the required batter of piles. This machine was operated with a Union Iron Works steam hammer size 2, and when in service was clamped to the track rails by automatic anchor hooks.

The Elgin, Joliet & Evanston Railroad Company used for several years a No. 7 McKiernan-Terry steam hammer suspended without leads from the point of a McMyler locomotive crane for driving round piles, sheet piles, the construction of foundations, cofferdams, and other miscellaneous pile driving service.

A Union Iron Works steam hammer suspended by a four-part tackle from the boom of a 16-ton, eight-wheel, M. C. B. track Brown hoist locomotive crane was used by S. W. Bowles Company, New York, for driving foundation piles. The hammer was provided with steam from the crane boiler and was simply hooked to the regular tackle, thus involving no change whatever on the crane equipment and enabling the crane to be used without delay for other purposes or to resume its service for pile driving without any modification or the adition or removal of any attachment whatever.

Railroad ditchers are a special type of locomotive crane adapted for installation on flat cars to excavate and handle material alongside the track. Pivoted leads have been suspended from their booms and advantageously used for pile driving, especially in cases of light construction.

Calgary Board of Trade

A contractors' section of the Calgary Board of Trade has recently been formed, with Mr. J. H. Garden as chairman and Mr. G. E. Mackenzie as secretary. This will be a means of bringing contractors together for the discussion of matters relative to their business, and at the same time a central office will be available, where plans may be seen. No doubt the newly-organized section will assist in furthering the interests of Calgary contractors.

The Dominion Bridge Company, Lachine, P.Q., has obtained a very large contract for machinery for the British America Nickel Corporation, Toronto. This company is equipping an extensive plant at Sudbury, Ont. The contract includes turbines, turbine blowers, and turbo alternators.

Lieut.-Col. Monsarrat Tells Toronto Branch, C.S.C.E., of Quebec Bridge

LIEUT.-COL. MONSARRAT, chairman and chief engineer of the board of engineers responsible for the final success of the Quebec Bridge, addressed the Toronto branch of the Canadian Society of Civil Engineers (Engineering Institute of Canada) on Tuesday evening, February 12, in the Chemistry and Mining Building at the University of Toronto. Col. Monsarrat delighted his audience by his simple, though comprehensive, description of the details which led up to the final successful conclusion of this, the greatest piece of bridge engineering of modern times. He touched briefly on the history of the project and the circumstances which resulted in the Dominion Government deciding to go ahead with the work, the disappointments of 1907 and 1916, and, finally, the almost superhuman precautions which ended so auspiciously on September 17, 1917. The lecture was illustrated by views of the work in its various stages.

Lt.-Col. C. N. Monsarrat.
British and Colonial Press Photo.

At the conclusion of the address Professor Haultain moved, and Mr. G. A. McCarthy seconded, a hearty vote of thanks.

Asphalt Production

STATISTICS just completed under the supervision of J. D. Northrop, of the United States Geological Survey, Department of Interior, indicate that the year 1916 was one of prosperity for the asphalt industry in the United States. The quantity of natural asphalt, including bituminous rock, grahamite, gilsonite, wurtzilite, and the natural paraffin, ozokerite, produced and sold at mines and quarries in the United States in 1916 was 98,477 short tons, valued at $923,281, a gain of 22,726 tons, or 30 per cent. in quantity, and of $396,791, or 75 per cent., in market value, compared with 1915. All branches of the asphalt industry shared in the general prosperity, and the gains in output included, except for grahamite, each of the principal varieties of natural asphaltic material produced in the country.

The quantity of manufactured asphalt produced in 1916 from crude petroleum of domestic origin increased only 3½ per cent., as compared with that produced in 1915, and the quantity of similar material manufactured in the United States from Mexican petroleum increased 47 per cent., as a consequence of which the net gain over production in 1915 was nearly 20 per cent.

The total sales in 1916 of manufactured asphalt derived from domestic petroleum amounted to 688,334 short tons, valued at $6,178,851. Of this quantity 404,000 tons, valued at $3,158,603, consisted of road oils and fluxing material, and 284,325 tons, valued at $3,020,248, consisted of solid or semi-solid products utilized for paving.

California led all other states in the production of manufactured asphalt, its output from sixteen refineries in 1916 amounting to 257,300 short tons, valued at $1,958,946, and consisting of 108,288 tons of road oils and fluxes, valued at $633,579, and 149,702 tons of paving residuals, valued at $1,325,367.

The total sales in 1916 of manufactured asphalt derived from Mexican petroleum amounted to 572,387 short tons, valued at $6,081,851. Of the quantity sold, 295,682 tons valued at $2,486,938 consisted of road oils and fluxes, and 276,705 tons, valued at $3,531,913, consisted of residuals utilized for paving.

Quebec Government Has Given Authority for Construction of Storage Dams

THE Quebec Government, in pursuance of its policy of developing the water-powers of the province, has passed several bills authorizing the Quebec Streams Commission to construct further storage dams—this authority, however, being subject to the consent of the Lieutenant-Governor-in-Council. Thus dams may be built on Lake Kenogami, a branch of Lake St. Jean; on the Chicoutimi and Sable Rivers; the St. Anne and Sauvanne Rivers; the Jacques Cartier River, and elsewhere. The expenditure authorized is $4,000,000, but it does not follow that these works will be carried out immediately. The commission has made studies and plans of the possibilities of water storage on numerous rivers. Under another bill, power is given to purchase railways, camps, a power plant, shops, machinery, etc., used by the St. Maurice Construction Company, in carrying out the contract for the building of La Loutre dam on the St. Maurice River. The price is not to exceed $500,000. The purchase is subject to the Shawinigan Water and Power Company, Brown Corporation, and Laurentide Company, Ltd., agreeing to reimburse the commission $1,000,000 over the price payable under a previous contract for supplying water by the damming of the St. Maurice. The payment of the $1,000,000 is to be spread over forty years. The St. Maurice Construction Company also agrees to renounce all claims for extra work incurred in the construction of La Loutre dam, a sum of $298,807 being mentioned particularly in the bill. The amount of $1,500,000 for the La Loutre work previously authorized is raised to $2,500,000.

Westinghouse, Church, Kerr & Co., Inc., engineers and constructors, Montreal and New York, have issued another of their characteristic illustrated cards, depicting the first refined potash plant in the United States—that of the Mineral Products Corporation, at Marysvale, Utah, where 30 tons of potash are produced daily.

New Technical School at Sherbrooke, P. Q., to Be Erected

The Quebec Legislature has passed a new law incorporating the Technical School at Three Rivers. By this special law the board of direction is entitled to issue bonds, guaranteed by the province, to the extent of $150,000, for the erection and equipment of the school, the province providing a yearly appropriation of $10,000 for its maintenance and, by agreement, the city of Three Rivers furnishing the same amount. Two representatives appointed by the city of Three Rivers and three by the Lieutenant-Governor-in-Council, and the principal of the school, will constitute the board of direction. The term of appointment is three years, without remuneration. The professor's staff will be appointed by the provincial secretary. The erection of this school, which will be situated in the heart of the city, has been zealously promoted by the Hon. J. A. Tessier, mayor of Three Rivers and minister of highways, who has been a consistent advocate of any progressive idea for the development of industry.

Activities of Toronto Branch, American Institute of Electrical Engineers

On February 1 Professor A. B. Coleman, of the University of Toronto, described to the Toronto branch of the American Institute of Electrical Engineers his recent travels across the South American Continent. The lecture was illustrated by a series of lantern slides and water-color sketches. On February 15 the section was addressed by Mr. C. R. Dooley, of the Westinghouse Company, Pittsburg, on the subject, "Training Men for Industry."

Several Canadian engineers have recently been elected to the standing committees of the A.I.E.E., among these Messrs. Wills Maclachlan, W. G. Gordon, H. B. Dwight, and W. L. Bird. One of the papers presented to the Toronto section—that of Mr. Harry Baker, of the Ontario Power Company, on "Testing Current Transformers"—has been accepted for publication in the general proceedings of the institute.

New Officers of Chatham Builders' and Traders' Exchange

The following have been elected as officers of the Builders' and Traders' Exchange of the city of Chatham, Ont., for the year 1916: President, J. A. Hildreth; vice-president, C. R. Gay; treasurer, W. H. Palmer; auditors, B. Blondie, J. Oldershaw; financial secretary, A. Tomlinson; recording secretary, R. McG. Coyle. For the coming season the exchange plans to participate actively in all the affairs relating to the building industry. According to the exchange, they have resolved as follows: "That each member will be a committee of one to get more material for the noble structure that is being built. The foundation has proven to have been made of the very best of material. Let each succeeding storey be bold, clean-cut, and upright."

A publication has recently been issued by the Mines Branch of the Department of Mines, entitled "The Radioactivity of Some Canadian Mineral Springs." This is the work of John Satterly, M.A., D.Sc., and R. T. Elworthy, B.Sc., and forms Part I. of Bulletin No. 16, which deals with the mineral springs of Canada, issued in two parts.

Change in Engineering Firm

The firm of Arthur Surveyor & Co., consulting engineers, 274 Beaver Hall Hill, Montreal, is now composed of Mr. Arthur Surveyor, M.Can.Soc.C.E., and Mr. R. DeL. French, A.M. Can. Soc. C.E. Mr. French, the new member of the company, has been principal assistant engineer for R. S. & W. S. Lea, consulting engineers, Montreal, since 1911. He is also lecturer in civil engineering at McGill University, having charge of the courses in municipal and sanitary engineering given in the Faculty of Applied science.

Trade Publications

Power-Driven Air Compressors.—The Canadian Ingersoll-Rand Company, Ltd., Montreal, has recently issued Bulletin K-301-A, describing two-stage power-driven air compressors, of the duplex type, "PLB-2." This is a 16 pp., 6 x 9 pamphlet, outlining notable features of construction, such as the "Circo" leaf valves, Haight 100 per cent. belt wheel joint, bath lubrication system, dust-proof frames and casings, etc., as well as the marked compactness of the design, with easy accessibility of all parts.

Personals

Lieut.-Col. C. N. Monsarrat, M.C.S.C.E., chairman of the Quebec Bridge Commission, has been elected a director of the Canada Foundries and Forgings Company.

Lieut. Stanley M. Sproule, St. Lambert, P.Q., of the Canadian Engineers, has been awarded the Military Cross. He is a graduate of McGill in civil engineering and architecture. Lieut. Sproule enlisted as a private and was given his commission on the field.

Mr. A. P. S. Glassco, B.Sc., A.M. Can. Soc. C.E., has been appointed secretary and bursar of McGill University, in succession to Mr. W. Vaughan, retired. Mr. Glasco graduated in engineering at McGill in 1901, and later was appointed assistant bridge engineer on the G.T.P. From 1905 to 1908 Mr. Glassco was assistant engineer on the Quebec Bridge Commission and afterwards assistant manager of the Cleveland Bridge Company Subsequently he was a member of the engineering firm of Atkinson, Glassco & Lawrence, Montreal.

Obituary

The death of Mr. Temple Frederick Sinclair, a well-known contractor and for many years a resident of New Westminster, occurred at his home in Vancouver on January 29.

Mr. Howard S. Stone, architect, of Montreal, died on February 14, from pneumonia, after an illness of two weeks. He was a native of Northampton, Mass., and began his practise in Montreal about twenty years ago. Mr. Stone designed several of the principal office and bank buildings in Montreal.

Mr. H. A. Bayfield, engineer in charge of the government's big assembling plant at Ogden Point, Victoria, where all the Imperial Munition Board ships built on the Pacific Coast are to be outfitted, died on February 13. He was formerly superintendent of dredges for British Columbia under the federal government, and before that was in charge of extensive wharf construction at St. John, N.B., and other Eastern seaports.

The estimates of the works department in Toronto for 1918, amounting to $2,287,953, have been passed by the works committee. The estimate submitted by Commissioner Wilson for the street cleaning department, $919,000, has been reduced by $19,000.

Mainly Constructional

East and West—From Coast to Coast

The first German freight motor vessel to be built entirely of reinforced concrete has just completed its trial trips at Hamburg. According to the Fremdenblatt. it is made of "a new kind of concrete, which only weighs half as much as gravel concrete."

The provincial authorities are taking up the question of the erection of a sanitarium in British Columbia, to take care of tuberculosis patients. The Dominion Government will pay 50 per cent. of the cost of a 200-bed building, to cost approximately $200,000, either as an addition at Tranquille or a new institution in the Okanagan.

The seventh annual convention of the Ontario Marble and Granite Workers terminated with a banquet at the Hotel Carls-Rite on February 7. About fifty were in attendance, and the following officers were elected: Honorary president, J. G. Gibson, Toronto; president, R. M. Jones, Ottawa; first vice-president. F. Lippert, Walkerton; secretary-treasurer, Frank Creler, Toronto.

The scheme for the installation of a coke oven in Hamilton, Ont., is being revived. The United Gas and Fuel Company submitted a proposition to the council two or three years ago, but it was not received with favor. The matter has been brought up again, however, and owing to the fuel shortage, the City Council is more anxious to see the project realized. The cost of such a plant would be approximately $3,335.000 at the present time, while a couple of years ago it might have been built for about two and a half million.

The Port Moody Steel Works are planning to remove the machinery from their present rolling mill to a new one to be erected upon Rocky Point. The Council of Port Moody has agreed to facilitate the removal and render what assistance they can towards securing government assistance for the extension of the plant and increase of output. The mill now in use is located unsatisfactorily for its present purposes, but it will be retained as a cast steel foundry and nut and bolt works. A six-ton. three-phase electric furnace is shortly to be installed there and another in the new plant.

At the annual meeting of the Engineers' Club of Toronto reports were presented showing its affairs to be in a very satisfactory condition, although a large number of the members are serving their country at the front. The following are the officers and directors for the year 1918: President, L. V. Rorke; first vice-president, J. R. W. Ambrose; second vice-president, M. P. White; third vice-president, T. D. LeMay; committee. H. G. Acres, W. A. Bucke, A. Burton, J. B. Carswell, E. L. Cousins, Arthur Hewitt, E. G. Hewson, C. H. Heys, W. R. McRae, T. H. Stevens, T. S. Young; secretary-treasurer, R. B. Wolsey.

A Kootenay branch of the Engineering and Technical Institute of British Columbia has recently been formed, with headquarters at Nelson, B.C. The following have been elected provisional officers: W. M. Cunliffe, chairman; A. E. Pickford, secretary-treasurer; A. E. Thompson, assistant secretary-treasurer; and a provisional committee has been formed including H. P. Thomas, R. W. Hinton, J. H. Soans, Leslie Crauford, W. M. Myers, George C. Egg, J. Dunlop, Will Haldane, G. H. Comrie, A. H. Green, C. W. Busk. Charles More, of Creston, and A. R. Heyland, of Kaslo. The institute, which is applying to the legislature at the forthcoming session for a charter, will be an organization composed of civil and mining engineers, architects, and members of the allied professions.

City Engineer Gray, of Hamilton, in a recently submitted report. presents an estimate of the value of the city's waterworks system, which he places at $2,937.735.01. The total cost of the system since its inception was in the neighborhood of $4,000,000, according to the engineer's findings, but in arriving at the figure already stated, allowance has had to be made for natural depreciation, obsolete plant, and methods, and costly piecemeal additions. The valution is useful for two reasons—it will enable the waterworks department to know exactly what the plant is worth and what it costs to produce a certain number of gallons of water, and it will show the yearly surplus or otherwise, after providing for all expenses connected with its operation, thus indicating when it is wise to raise or decrease water rates.

At a recent board of trade convention in Galt, Ont., at which representatives of Brantford, Kitchener, Fergus, and Galt were present, Mr. Naulon Cauchon, an engineer of the Irrigation Section of the Department of Interior, outlined a scheme for the development of what is known as the Metropolitan District. embracing all the territory between Kitchener and Hamilton. Mr. Cauchon proposed the utilization of the waters of the Grand River, and he pointed out that this plan would attain three very important objects—the prevention of floods by the conservation of the water in storage dams, the irrigation of a hundred square miles, and the production of thousands of horse-power of electric energy by hydro-electric development. Two vital necessities of the present time, he said, were greater production of foodstuffs and power. Irrigation would increase the agricultural yield, conservation of the flood flow would provide the means of producing power, and incidentally the flood menace would disappear. Mr. Cauchon's proposition was received so favorably by the convention that a motion was carried authorizing the Galt Board of Trade to prepare a resolution setting forth the meeting's approval of the need and feasibility of the scheme, to be sent to the Hydro-Electric Power Commission and the Minister of the Interior.

The T. Eaton distributing warehouse which is to be erected in Regina, according to present plans, will measure 500 ft. in length and 135 ft. in width, occupying the full length of Dominion Park, located on the west side of Rose Street. The building will be fireproof, built on the Turner system of flat-slab reinforced concrete construction, and both east and west elevations will be of concrete, with bush-hammered finish. The end facing Sixth and Seventh Avenues will be faced with pressed brick. All the sash in the building will be of steel and glazed with wire-glass, and there will be practically no wood used except for the entrance doors, which will be of quarter-cut oak. The floors of the main entrance will be of terrazzo, with marble base, while the other floors throughout the building will have a cement finish. On account of the great length of the building, two expansion joints are being provided to take care of the variations in temperature, these joints being located where the building is divided into three sections by heavy partitions of hollow welded steel. The stairs will be of concrete and doors of metal with steel frame. Round concrete pillars will be used to support the floors, and the bays will be twenty feet wide each way. The building is to be heated by three tubular boilers. located in the basement. Lavatories and drinking fountains are being provided on every floor, and on the roof space provision is made for two men's lunch rooms. Four sprinkler tanks will supply pressure for fire protection purposes. Tenders for the construction of the warehouse closed recently, bids being submitted by a number of local contractors. Woodman & Cubbidge, Winnipeg, are the architects.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Armagh, Que.
Tenders will be called about March 15 for waterworks, etc., costing $40,000 for the Town Council. Engineers, Gouvin & Beauchemin, 147 de la Montagne Street, Quebec.

Brooke Township, Ont.
Specifications are with the Commissioner, Clarence Atkin, R. R. 1, Inwood, who will receive tenders until March 2 for repairs to the Weidman drain for the Township Council.

Harwich Township, Ont.
Tenders will be received by the clerk, Geo. W. Riseborough, Blenheim, until 6 p.m., February 28, for drainage work estimated to cost $18,000, for the Town Council. Engineer, W. G. McGregor, C.E., Chatham.

Kincardine, Ont.
Town Council contemplate purchase of sewage tank and repairs to Queen Street bridge. Clerk, John H. Scougall.

Orillia, Ont.
Town Council contemplate the construction of bitulithic paving on Front Street. Clerk, C. E. Grant.

Railroads, Bridges and Wharves

Oakbank, Man.
Tenders being received by the engineer, C. H. Holden, C. P. R. Station, Winnipeg, until February 20, for the erection of a $12,000 one-storey, frame station for the Canadian Pacific Railway, head office, Montreal.

Portage la Prairie, Man.
The Rural Municipality contemplate the erection of two cantilever bridges at High Bluff Ferry and Poplar Point Ferry. Clerk, D. McCowan, Portage la Prairie.

Rainy River, Ont.
The Canadian Northern Railway, head office, Toronto, are preparing plans for two-storey brick station building. Superintendent of Building Department, T. H. Graham, Port Arthur.

St. Narcisse, Que.
The North Shore Power Co., Power Bldg., Three Rivers, will build a $15,000 dam. Chairman, W. B. Baptist.

CONTRACTS AWARDED

Dartmouth, N.S.
The Standard Construction Co., Metropole Bldg., Halifax, have the general contract for $3,000 wharf at Woodside Street for the Imperial Oil Co., Upper Water St., Halifax.

Grand'Mere, Que.
The Dominion Bridge Co., Ltd., Dominion Station, Lachine, have the steel, and Jos. Gosselin, 85 Dalhousie Street, Quebec, the concrete contract for $70,000 bridge over River St. Maurice, from here to Lac a la Tortue for the Canadian Northern Quebec Railway Co., 160 St. Andre St., Quebec.

Halifax, N.S.
The Standard Construction Co., Metropole Bldg., have the general contract for $16,000 and a $3,000 wharf at Lower Water Street for the Military Authorities. Engineers' Department, Mitchell Bldg., Lower Water Street.

The Nova Scotia Construction Company, Upper Water Street, have the general contract and will let roofing for $35,000 extension to freight shed for the Department of Railways & Canals, Dominion Government, Ottawa, who will let plumbing, heating, plastering, painting and electrical work.

Mosa Township, Ont.
The Webster Construction Co., Adelaide and York Streets, London, have the general contract for concrete culvert for the Township Council.

Ritchot, Man.
A. Powell, Mulvey Street, Winnipeg, has the general contract for 29 ft. x 18 ft. wooden pile bridge for the Municipal Council.

Public Buildings, Churches and Schools

Agincourt, Ont.
St. Timothy's Anglican Church have purchased a site on Main Street on which they will erect a church. Pastor, Rev. G. G. Dreyer, Scarboro Junction.

Alberta, Province of
Plans are being prepared for addition to the hospital for the insane for the Department of Public Works, Provincial Government. Minister, L. C. Charlesworth, Edmonton. Architect, Mr. Blagey, care of the Department.

Almonte, Ont.
Tenders are being received until March 1 for steam or hot air heating at Martin Street school for the Public School Board. Chairman of property commission, D. Williams.

British Columbia, Province of
The Military Hospitals Commission, 22 Vittoria Street, Ottawa, contemplate the erection of a $200,000 tubercular sanitarium. General superintendent, J. H. W. Bower.

Dartmouth, N.S.
The Stairs Memorial Church, Windmill Road, contemplate the erection of a church. Pastor, Rev. J. A. McGlashen, Windmill Road.

The Church of England Authorities, Barrington Street, contemplate the erection of a church at Dawson Street and Windmill Road. Superintendent, Rev. Canon Vernon.

Flagstaff, Alta.
Plans and specifications with the secretary-treasurer, A. W. Smith, who will receive tenders until March 1 for the erection of a school for Flagstaff School District No. 3505.

Halifax, N.S.
Plans and specifications with the architect, W. J. Busch, Bedford Row, who will receive tenders until March 1 for steam heating system for St. John's Presbyterian Church.

Kaye Street Methodist Church and Grove Street Presbyterian Church contemplate the erection of a temporary at Gottingen and Yonge Streets. Pastor, Rev. W. J. Swetman, East Young St.

Repairs costing $3,000 to St. George Church, Brunswick Street, are contemplated. Rector, Rev. H. W. Cunningham, Cornwallis Street.

The Relief Commission, Sackville St., contemplate the erection of a hospital. Secretary-treasurer, Ralph P. Bell, Sackville St.

Lougheed, Alta.
Lougheed, Groveland, Park, Green Valley, Parkhill and Caledonia School Districts, contemplate the erection of a consolidated school. Address, A. Pope, Lougheed.

Manyberries, Alta.
The Consolidated School District of Manyberries, Hedley, East Manyberries and South Manyberries, contemplate the erection of a consolidated school. Secretary-treasurer, J. M. Courtney, Manyberries.

Mimico, Ont.
The Department of the Secretary, Provincial Government, Toronto, have included in their estimates for 1918 $1,500 for improvements and additions to farm buildings, $2,000 for firehall, $75,000 for two additional buildings, and $1,500 for fire alarm and fire protection system.

Montreal West, Que.
The Board of Education are having plans prepared for a high school. D. J. Spence, 246 Beaver Hall Hill, is the architect.

Orion, Alta.
The Consolidated School District contemplate the erection of a new school or the conversion of two schools into one. Address, Secretary-treasurer.

Ottawa, Ont.
The Public School Board have included in their estimates $17,170 for repairs to schools, and $51,525 for furnishings. Chairman, J. B. Watson.

Point Grey, B.C.
The Department of Public Works, Provincial Government, contemplate the erection of university building at a cost of $175,000. F. Carter Cotton, 1250 Georgia St. W., Vancouver, is on the Board of Governors.

Port Moody, B.C.
School Board contemplate the erection of a school.

Riverton, N.S.
The Pictou County Council contemplate the erection of a hospital for the in-

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Canadian Shipbuilding and Maritime Development

IN its decision to launch upon an extensive shipbuilding enterprise, it would appear that the Dominion Government is following a wise course, dictated alike by the exigencies of the present and the necessity of laying plans beforehand for the maintenance and development of Canada's prosperity after the war is over. Some are of the opinion that the government has delayed action too long in the matter, and that the present indications are that the final crisis of the war will be reached during the coming spring or summer, and will probably have passed before Canada's shipbuilding program is well under way. Nevertheless, there will undoubtedly be a shortage of ships for a very considerable time to come, and a supply from the Dominion will help to relieve the situation.

It is in the light of Canada's future development, however, that the citizens of Canada will approve the step taken by the government. How is the addition of shipbuilding as an important branch of Canadian industry going to affect trade in general? It seems to us that if the undertaking is handled in the right way by the government it is bound to be of great advantage to the country from many standpoints. First, in the period after the war it may prove a big factor in the maintenance of industrial equilibrium; it will provide a new field for the employment of men who return from the battle-front to civil life and those who are left without work owing to the cessation of war industries, and it will help to maintain and stimulate activity in many trades which will be adversely affected at the close of hostilities. There is reason to expect, for example, that some of our big steel plants which have been engaged on the manufacture of shells will take up the rolling of ship plates on a large scale.

However, the more important aspect of the undertaking is the effect which the provision of a merchant marine is going to have on the status of Canada as a nation. This depends more or less on what action the government will take as regards the development of foreign trade. We do not require a merchant marine to carry products or manufactures from outside sources to us—we have more materials and resources than we can possibly make use of—but we do need vessels to carry Canadian materials to foreign markets.

This is an age of aggressive salesmanship, on the part of individuals, corporations, and nations, and if Canada is to keep within sight of her more powerful competitors she must not adopt the policy of waiting until customers come within her borders to buy her wares. On the contrary, she must invade foreign markets, discover prospective purchasers and their needs, and place her merchandize before them in the most attractive way. Enterprise of this kind, however, demands action on the part of the government. Other countries send their trade representatives to every possible market and provide organizations for facilitating the business transactions of their manufacturers. In this particular Canadian manufacturers are woefully handicapped, for we have but few direct trade representatives, though we are capable of producing practically every commodity. Here it is that the Department of Trade and Commerce must render assistance by surveying foreign markets and placing agents to open up the way for the introduction of Canadian products, while at the same time the Department of Marine provides the means of transportation.

We in Canada are perhaps a little prone to consider merely the country's internal development and forget the possibilities of expansion by intercourse with other nations. Naturally the two are interdependent, and it is the most logical thing in the world for Canada to develop as a maritime country. She has agricultural and mineral products which are acceptable in every market, and her manufacturers have facilities for producing all kinds of commodities. At the same time she has the longest shore line of any country in the world, great navigable rivers and lakes, and, in consideration of her population, an unequalled system of railways. Besides, new and unlimited fields for the exploitation of Canadian manufactures are opening up, and will continue to open up, after the war; an awakening China and, we hope, Russia will demand commodities for which previously they had no use. The opportunities are tremendous, and all that is required is the enterprise and determination to take advantage of them. Let us not forget that it was from the nucleus of a small but indomitable maritime people that the greatest empire in the world has developed.

To Remedy Montreal's Deficient Water Supply

If the present rate of increase in water consumption keeps up, Montreal will, in two or three years, find its supply inadequate. At times during the present winter the consumption has been dangerously near the full capacity of the conduit, and it is generally admitted that the time is not far off when the city will have to face the problem of securing an additional supply. The new filtration plant will soon be in operation, but this will only about cover present needs. Any reserve required will have to be obtained from the conduit, which is now the present source of supply and which will feed the filtration plant. The capacity of the conduit is not sufficient to provide for a very heavy reserve. The question of the enlarged aqueduct is bound up with the water supply, and there are those who believe that the aqueduct would, if finished, serve as the best source of supply, leaving out of consideration the proposed hydro-electric development, which has been the subject of such prolonged controversy. If Montreal desires to provide an adequate supply of filtered water for future requirements, means will have to be taken almost immediately to obtain a larger supply and also to enlarge the filtration plant, for which there is plenty of space available. Probably the new commissioners will take up this matter at an early date, otherwise Montreal will find itself in two or three years on a scale of rationing so far as water is concerned.

The pumping plant is practically obsolete, and all the engineers who have recently reported on the aqueduct have agreed that a new pumping plant is imperative, and Messrs. H. E. Vautelet, A. St. Laurent, and J. B. McRae proposed an electric motor-driven pumping station to take care of an addition to the filtration works, of one hundred million imperial gallons per day.

Alleged Defects in Montreal Civic Administration

In a long report dealing with Montreal's civic administration, the New York Bureau of Research refers to the public works department, which, it is declared, has certain fundamental defects. Under present conditions, authorization of public improvements such as streets and sewers are made by council and the board of control. The chief engineer of the city has no voice in the matter other than to advise those bodies upon request. The distribution of public improvements throughout the city has not ben in accordance with any well-conceived plan based on a comprehensive study of the city's needs. In fact, in many cases the controlling elements in securing appropriations for public works appear to have been political expediency. As a natural result of this policy, particularly in regard to street improvements, there has been extensive construction of permanent pavements in sections of the city where the need in no way justified the expenditure. This cost has been very heavy, and has been borne entirely by the city.

Two other defects in the present improvement policy of the city which have hampered the effects of administration of the department of public works are: (1) Authorizing the execution of improvements, irrespective of season and without providing sufficient time and adequate funds for the study of these improvements; and (2) authorizing the execution of public improvements by city forces without competitive bids. The net results of No. 1, particularly in the cost of sewer improvements, has been the excessive cost of construction.

The present street paving problem is one of resurfacing and construction rather than maintenance. It is urged that immediate action be taken to organize a maintenance force adequate to keep in repair those pavements which have recently been constructed and have not yet fallen into that condition of disrepair which is so common in many parts of the city.

As to the department of building inspection, the bureau recommends that the inspection of public buildings by the department of building inspection be discontinued and that this function be placed under the jurisdiction of the fire chief. There is now ample force in the fire department to carry on the service without additional staff. A new building code is insisted upon.

It may be added that the entire report is the result of several months' examination of various departments, and that, while some of the recommendations may be generally approved, others are open to criticism. A lack of appreciation of local conditions is apparent in some of the recommendations, and in other respects the proposals would probably result in greater confusion and increased expenditure.

Training Men for Industry

In a talk given before the Toronto section of the American Institute of Electrical Engineers on February 15 by C. R. Dooley, manager of the education department of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., he outlined the admirable work that is being done by this company in East Pittsburg in training the trade and engineering apprentices in the manufacturing side of electrical engineering. Any educational method should have as its goal, leadership, workmanship, and spirit. The speaker claimed that in training men for leadership they could obtain workmanship and spirit as by-products.

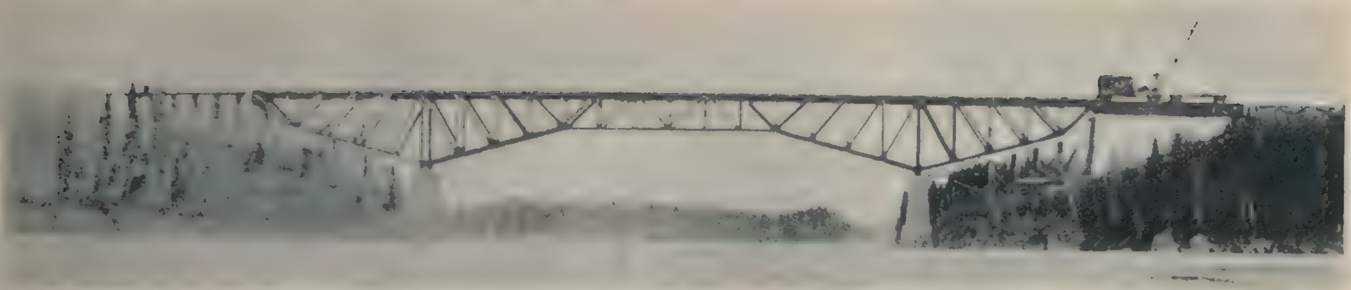
In supplying technical assistants to the various executives of the Westinghouse Company, Mr. Dooley found that these executives wished their subordinates to have, first, the human characteristics, such as good judgment, initiative, analytical ability, courage, etc., and, as of less importance, technical knowledge of the fundamentals of their profession.

Tests Aid Selection

The choosing of men was outlined, various methods being employed, among which are phrenology, mechanical tests of Munsterberg, and the tests of Warfield Scott of the Northwestern University and Thorndike of Columbia. After the men are selected, the method of training is to place the men in the shops and to carry on their training by presenting to them in a systematic way a series of questions that apply to their daily work. These men can obtain the answers to their questions by asking their foremen, studying the literature of the company, or by any other means they wish.

Mr. Dooley emphasized the value of personal discovery, and he said that the best type of teacher was the trained fellow-employee. The situation, more or less summed up, would be that people are slightly interested in things they are told, but vitally interested in things they take part in.

After the paper a most interesting and heated discussion was conducted, some of those taking part being Professors Baker and Henderson of Queen's University and Professor Price of Toronto University.



The Nelson river cantilever bridge at Manitou Rapids on the Hudson Bay Railway.

Overhead Cableways Serve to Erect Steel Bridges on Hudson Bay Railway

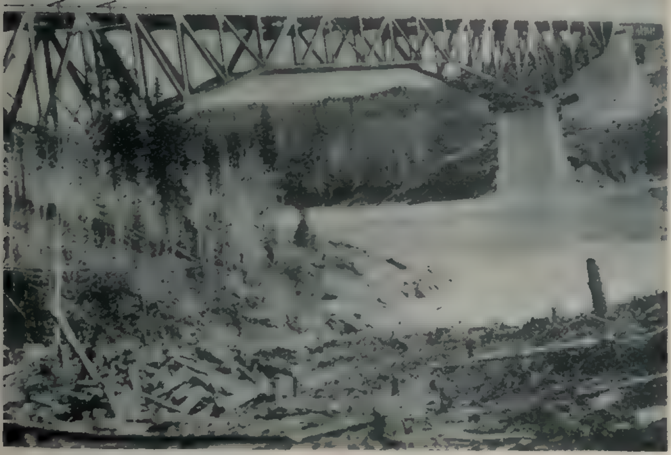
High River Velocity, Making Falsework Impossible, and Remoteness of Site, Add Difficulties to Erection of Large Structures

The Manitou Rapids Cantilever Bridge

By P. B. Motley*

THE bridge at Manitou Rapids, on the Hudson Bay Railway, over the Nelson River, consists of a cantilever structure, with an actual opening of 304 ft. 6 in. between centres of piers. The two anchor arms are each 108 ft. 9 in. between centres of pins, and the suspended span in the centre of the river is 87 ft. between centres of end links. There is also a flanking span on the east end of 85 ft. 4 in. out to out of girders.

The Nelson River at this point is extremely deep, and the discharge through the 300 ft. channel is said to be almost as great as the Lower St. Lawrence. Velocity and depth of water made it, therefore, a problem of dispensing with any description of falsework. The problem of designing a suitable structure resolved itself into:



Bridge over Nelson river at Manitou Rapids is cantilever structure, nearly 600 feet long.

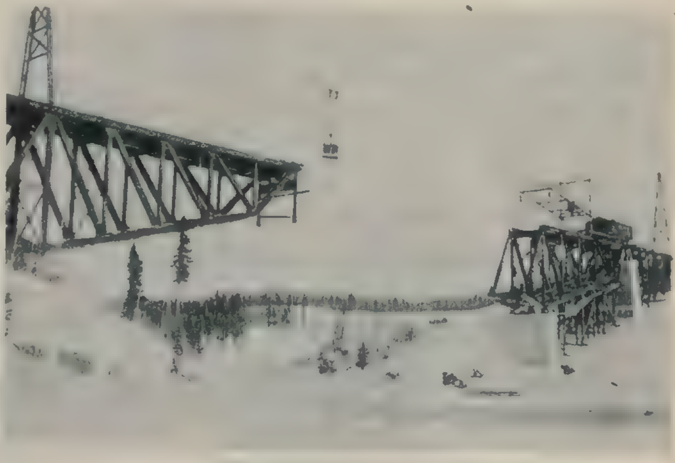
(a) A simple span of approximately 300 ft., with two side spans sufficiently heavy to act as anchors for a cantilever method of erecting the centre span.

(b) A cantilever bridge pure and simple.

(c) An arch bridge.

Cantilever Bridge Adopted

After carefully considering the method of erection, transporting of material, and the aforesaid necessity of doing without falsework, it was finally decided to use a cantilever bridge, general details of which are shown in the photographs herewith.



Overhead cableways important part of construction equipment.

The profile shows rock bottom throughout, and there is sufficient height at both ends of the cantilever arms to build a concrete anchor of sufficient size to take care of the uplift. The west anchor is the abutment, and the east anchor is the pier on which the flanking span rests. The main trusses, both for the cantilever and the suspended span, are spaced at 20 ft. centres, and consist of stiffened riveted construction throughout, while the cantilevers themselves have rocker pins on the main piers as well as at the points of attachment of the suspended span. Anchor facilities for expansion are provided over the anchor abutment and pier, as well as at one end of the suspended span by suitable links capable of horizontal movement. The 80 ft. flanking span has girders 9 ft. centre to centre, with ordinary riveted laterals and brace frames.

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*Bridge engineer, Canadian Pacific Railway.

The live load for which the bridge was designed is Cooper's E-50; the impact formula and units were according to the American Railway Engineering Association specification for steel bridges, and the general specification was the Dominion Government's of 1908.

The substructure presented no serious difficulties, being built in all cases in the dry. The abutments were designed as buried piers, with small wing walls above the finished line of fill; in addition, these abutments had sufficient stability to act as retaining walls. The piers had sufficient size at their tops to take care of the pier members. They had battered sides and ends to take care of the horizontal forces and also for appearance. The anchor pits have small tunnels provided at their lower ends, so that access from the outside for inspection may be always possible.

Erected By Overhead Cable

The erection of the structure was carried out by the overhead cable method. Towers were erected over the west cantilever pier and the east abutment. Over these the main cables were strung and securely double-anchored in the rock, about 200 ft. back of them. The main cable which spanned the opening was 2¼ in. in diameter. On this cable was a trolley, from which were suspended suitable sheaves, operated by 5/8 in. cables, which were led back to drums on the engine on shore, which provided power for lifting and lowering the various pieces handled by the sheaves. The trolley was moved back and forth by 5/8 in. cable, supported at intervals on suitable hangers, which also supported the main operating 5/8 in. cable to prevent excessive sag and entanglement.

The actual order of operation was as follows: The west anchor arm was erected on falsework by means of a derrick car, beginning with the main posts over pier 2 and working back on the abutment. Then the cantilever arm was erected for 108 ft. 9 in. as a cantilever by means of the derrick car. The west cable tower was then erected over pier No. 2, and the east anchor arm was erected on falsework by means of the travelling trolley. The east cantilever arm was then carried out over the river in the same manner as the west cantilever arm, and the suspended span was, in turn, erected, member by member, out from the cantilever arms until it met in the centre. The girder span at the east end was put in last by means of pony bents and jacks in the ordinary manner.

The work as a whole is interesting, owing to the fact that it was carried out at a long distance from the bridge company's headquarters, part of the operations being done during the winter, but, notwithstanding these facts, there was no hitch of any kind.

The contractors for the masonry were McDonald Brothers, Port Arthur, Ont., who were sub-contractors under the general contractor, J. D. McArthur, of Winnipeg. The contractors for the steel work were the Canadian Bridge Company, of Walkerville, Ont. The work generally was done under the direction of Mr. W. A. Bowden, chief engineer, Department of Railways and Canals, Ottawa, with Mr. P. B. Motley as consulting engineer.

The Kettle Rapids Bridge

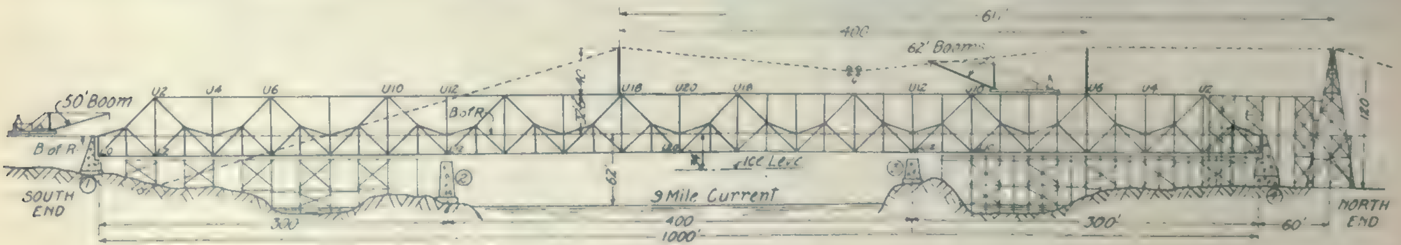
By Sterling Johnson*

THE Kettle Rapids bridge, on the line of the Hudson Bay Railway, crosses the Nelson River at a point about 332 miles north of The Pas, Manitoba. The Nelson River at this point forms a deep, narrow gorge, through which flows a swift rapids, directly in the way of the site chosen for this crossing. The banks on both sides consist of solid rock for a considerable distance back of the shores, and were a determining factor in selecting the continuous girder type of truss adopted.

The design consists of a single-track through-truss structure, 1,000 ft. long, continuous over four supports. The channel span is 400 ft. long, centre to centre of pier members, and the two flanking arms 300 ft. each. The trusses are of the Warren type, having 50 ft. main panels, subdivided to form two 25 ft. stringer panels. They are 50 ft. deep centre to centre of chords, and are spaced 24 ft. apart. All truss joints are riveted throughout. The floor system is the ordinary open floor type, having wooden ties carried on two lines of built-up stringers, which frame into the webs of the floor beams. The simplicity of this design greatly facilitated the fabrication and erection, and has many commendable points.

Staging for erection of Kettle Rapids bridge was out of the question, so that trusses were erected as cantilevers.

The erection of this crossing was of special interest, as it was out of the question to use staging of any kind



Erection diagram of Kettle Rapids bridge.

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*Assistant manager of construction, Canadian Bridge Company.

for the channel span. Furthermore, the remoteness of the site, being at the end of a long construction line leading from The Pas, precluded the possibility of bringing material for the north end in from that side and the problem of getting this half of the structure across and in place economically formed one of the chief considerations.

The following erection program was adopted: The south arm between piers Nos. 1 and 2 was erected on wooden staging with an ordinary derrick car, the only unusual feature being that L-O was erected 10 inches lower than its normal elevation, in order to allow for deflection in cantilevering. The truss as a whole was also erected on the permanent pier member rollers about 5 inches closer to the shore than its normal position. The main joints were then completely riveted and the derrick car erected the balance of the south half of the crossing as a cantilever from L-12 to L-20. The riveting followed the erection very closely, so as to take care of the erection stresses.

Overhead cableway aids erection of steelwork.

Cableway Used for Erection

A cableway tower was then erected on the north shore, materials for it being hauled by team over the ice at a point some distance from the crossing. A short cableway bent was also erected on the completed truss at U-18, and a double cableway made of 2¼ in. diameter cables was erected on these towers and securely anchored at both ends. These two cableways were operated by two double-drum hoisting engines, and carried a flexible equalizer designed for lifting 15 tons. The materials for the north end were then brought out on cars to the extreme end of the cantilever truss on the south side, and materials transferred by means of this cableway to the north side.

The staging for the north anchor arm was first erected, and on this a light double boom traveller assembled. The steel work was then transferred and placed with this traveller, starting at L-12 and erecting the lower half of the anchor truss, backing up with the traveller until L-O was reached. The traveller was then jacked up so as to bring the trucks level with the top chord of the span, and the balance of the steel for the north anchor arm completed, going forward from U-2 to U-12. After riveting this anchor arm the cantilever portion of the truss between panels 12 and 20 was easily completed, with the traveller running out on the top chord.

The whole of the south half of the bridge was then jacked forward on the permanent pier member rollers and a coupling made at L-20. After this joint was riveted, jacks were applied at the two extreme ends of the bridge, points L-O north and south ends. These ends were raised until the joint at U-20 was closed, after which the four corners were raised simultaneously until a load of 118½ tons was registered on each of the four jacks, which fixed the distribution of the dead load stresses throughout the entire structure.

The entire work was under the general supervision of Mr. W. A. Bowden, chief engineer, Department of Railways and Canals, Ottawa. The bridge was designed by Mr. W. Chase Thompson, consulting engineer, New Birks Building, Montreal. The superstructure was fabricated and erected by the Canadian Bridge Company, Ltd., Walkerville, Ont.

Conditions Detrimental to Creosoted Floors

Premature Failure Due to Unusual Shrinkage of Blocks or Expansion Causing Floor to Buckle—Decay Seldom Causes Failure

CREOSOTED wood block floors seldom fail from decay. If properly manufactured and treated and properly installed they wear indefinitely, but when the floors do eventually fail it should be from wear alone. Occasionally, however, they do not give the long and satisfactory service which is expected of them. When premature failure occurs it is usually either from unusual shrinkage of the blocks, which causes them to become loose, or from their expansion causing the floor to buckle. Floors subjected to considerable humidity or moisture frequently fail for the latter reason. This statement of conditions affecting the longevity of creosoted block floors was made in a paper read at the recent convention of the American Wood Preservers' Association, by Lambert T. Ericson, contracting engineer of the Jennison-Wright Company. He further asserts:

When the blocks become loose, foreign matter soon sifts between and works under them, making the floor rough and uneven. The blocks then have a tendency to travel with the traffic and, as they get out of level, soon broom on the ends and break up. This condition also permits water to get under the floor, which materially hastens the second usual cause of failure—expansion. Expansion at this stage will cause the floor to buckle, since the joints are full of incompressible matter. However, excessive moisture will cause the floor to buckle under any conditions unless proper provision is made to accommodate the resulting expansion.

In relaying a floor after buckling it is difficult to restore the original surface. Any unevenness will hasten splintering.

Provision for Expansion

Expansion joints, an inch or thereabout in width, should be always placed along all walls and around columns, machine bases, and other fixed points. Expansion joints of this width cannot be placed across the traffic without resulting in depressions and rough spots. Inasmuch as creosoted blocks have been known to expand 5 per cent. in passing from the dry to the saturated state, a floor 60 ft. wide would, under similar conditions, expand 36 in. Of course, this percentage of expansion is the extreme limit and improbable of occurrence; still, it is obviously impossible, where variable conditions of moisture exist, to take care of expansion merely by means of expansion joints along the walls and columns.

The logical and practical way to take care of expansion is by filling each and every joint with a compressible and waterproof material. In rectangular blocks most of this expansion occurs at the ends. The width of end joints required can be calculated very closely, and when this is done and the requisite provision made, no trouble will be encountered.

Especially where dry or heated conditions are to be encountered, one of the most essential requirements is that the lumber shall be absolutely air-seasoned. Inasmuch as untreated lumber will contract more than 6 per cent. in volume in passing from the green to the dry state, it should be apparent that there is no possible way to keep blocks tight in the floor if any such condition of shrinkage is to be encountered after their installation. That would mean that a block measuring 4 in. wide by 8 in. long would contract ¼ in. in width and ½ in. in length in drying out. It is a fact that lumber well air-seasoned will shrink further when subjected to steam-heated conditions, but it is possible to offset this shrinkage by the use of a plastic filler between joints.

Floors Subjected to Moisture

Floors that are to be constantly subjected to moisture or to humid conditions are an exception to this rule. They should be manufactured preferably from only partially seasoned lumber; or, if dry lumber is used, it should be subjected to live steam to swell the blocks during the treatment. This condition, however, is not a usual one, and merely illustrates the impossibility of laying down rules that will fit all cases. It is also frequently advisable to use a heavier oil treatment.

The matter of the foundation for the floor is also very important. It goes without saying that if the foundation gives way the surface will do likewise. Concrete of the requisite depth and composition to withstand the expected load should always be used, unless it is impossible for other reasons. If timber is used, it should be given a preservative treatment to prevent decay. In modern factory construction, however, it is seldom that concrete cannot be used.

The advisability of the use of a cushion between the concrete and the blocks is a matter of much debate. It should be remembered that when one is used its sole function is to level up the inequalities of the concrete base, to afford the blocks an even bearing, and to permit them to be surfaced smooth by rolling or tamping.

Steps Taken to Organize Montreal Branch of C.S.C.E.

ONE of the recommendations of the Committee on Society Affairs of the Canadian Society of Civil Engineers was the formation of a Monttreal branch; this was followed by an authorization of the council, and on February 14 steps were taken to organize the branch.

Mr. W. J. Francis presided at the meeting held in the society's rooms. He pointed out that, under the new by-laws, the branch would be independent of the council, a condition not possible under the old regime. There would be more attention to purely local matters and also to public questions such as were outlined by Mr. Fraser Keith, the secretary, in his paper read before the Ottawa branch—a paper which had received favorable comment in the technical press of America. The branch would be able to make representations to council, another thing which had previously not been possible; further, representations to council could be made on the qualifications of applicants. Another advantage would be the interchange of papers and intercourse with other branches. The formation of a Montreal branch would enable the society to organize a Province of Quebec division, leading to a greater recognition by the public of the engineering profession, which the council considered as very important. Mr. Francis stated that he had been asked by the council to again become chairman of the Papers Committee, which would now embrace the whole organization of the society in Canada.

Considerable discussion followed on the subject of the procedure to elect officers and a committee and to draw up by-laws. The following took part in the discussion: Sir John Kennedy and Messrs. A. Surveyor, A. Crumpton, F. B. Brown, J. A. Jamieson, A. D. Swan, H. G. Hunter, and W. D. Lawrence. After several suggestions, it was agreed, on the motion of Sir J. Kennedy, seconded by Mr. H. G. Hunter, to appoint the following as nominating committee: Messrs. R. M. Hannaford, F. B. Brown, L. G. Papineau, J. A. Duchastel, M. B. Atkinson, and H. G. Hunter, who will name two candidates for each position on the executive, which will consist of a chairman, vice-chairman, secretary-treasurer, and six committeemen. Other candidates to be included in the nominations must receive the certified support of five corporate members of the branch. The chairman, vice-chairman, and secretary-treasurer are to be elected for one year, while the three committeemen receiving the highest number of votes will be elected for two years and the three others for one year; thereafter the committee will be elected for two years, three at each election. The election will be by letter ballot, by members of the society resident within 25 miles of Montreal. The nominations will be announced on February 28 and the ballot declared on March 14.

Officers of Stratford and Perth County Builders' Exchange

THE annual meeting of the City of Stratford and County of Perth Builders' Exchange was held on February 1. The yearly reports showed flourishing conditions in all departments, including that of finance.

During the past year another of the members had returned from the firing line in the person of Lieut. Keyes, who gained his commission at the front, having gone over with the 34th Battalion as a private. Both Lieut.-Col. J. L. Youngs and Lieut. John Keyes have again gone across the Atlantic, the former in charge of a Western Ontario battalion, the latter to resume his command of a construction camp.

The officers elected for the year were: Honorary president, Lieut.-Col. J. L. Youngs; honorary vice-president, Lieut. John Keyes; president, A. G. Garner; first vice-president, J. W. Lillow; second vice-president, A. G. Everitt; secretary-treasurer, Robert Marson; board of directors: F. Ingram, George Burdette, James Player, Lorne Cook, Emil Kalbfleisch.

Analysis of Wood Block Pavement Failures

Satisfactory Service When Bituminous Filler is Used, Regardless of Creosote Treatment — Shifting Sand Cushions Cause Trouble

EXAMINATION of wood-block pavements in thirteen Southern cities was made in 1917 by the United States Forest Products Laboratory, to obtain information on the service experience with various methods of treating and laying. Almost without exception, satisfactory service had been obtained when a bituminous filler had been used, regardless of whether light distillates or heavy tar-oils were used. There was very little evidence of trouble resulting from poor treatment, or to the quality of oil used, but sufficient trouble from shifting sand-cushions was noted to condemn this method of construction, even though there is a slight saving in cost compared with mortar cushions. The numerous satisfactory streets where proper construction methods were used prove that wood block can be successfull used if proper methods of construction are adopted. Mr. C. H. Teesdale, of the Forest Products Laboratory, described these investigations at the recent convention of the American Wood Preservers' Association.

Most of the pavements inspected were laid within the last six years. Southern yellow pine was used in all cases, and usually the treating records showed that the blocks were green and were steamed before treatment. The earlier specifications called for from 16 to 20 pounds of heavy tar oils. The pavements were usually laid on sand cushions and filled with sand fillers.

The development of very serious expansion trouble in these pavements led to a quite universal change in the specification early in 1915. Imported English distillate oil was substituted for the heavy paving oils, and the blocks were laid on a mortar cushion with asphalt filler. As a rule, green timber steamed before treatment was used as before.

Sixty-one pavements were investigated, but four of these, originally laid with sand cushion and filler, had been relaid with bituminous filler. Thirty-two were treated with heavy tar oils and 33 with light oils; 35 had sand filler and 30 bituminous. Swelling troubles which necessitated relaying considerable areas of pavement are included in the column of "serious trouble," while all other cases of expansion which were found or reported are included under "slight trouble."

Trouble With Sand-filled Pavements

Of 35 pavements laid with sand filler and cushion 23 gave serious trouble and 8 gave slight trouble from expansion. Only three pavements of the 35 gave no expansion trouble, and one of these had been in service but a few weeks when inspected. The blocks had bled severely in each of the three exceptions, probably helping to waterproof the surface.

Thirty pavements were laid with bituminous filler, 20 of them on mortar and 10 on sand cushion. None gave serious trouble from expansion; 4 gave slight trouble and 26 gave no trouble. Of the four giving slight trouble, three were laid on sand cushions; one of them between the rails of a street railway, one other used liquid petroleum instead of asphalt or pitch for filler, and both of the other cases occurred on bridges.

It will be noted that of 32 pavements treated with distillate oils 23 were laid with bituminous filler, and of 33 treated with heavy tar oils only 7 were laid with bituminous filler. Serious trouble occurred with either oil when sand filler was used and did not occur when bituminous filler was used. In four cases, where the blocks were originally laid with sand filler, so much trouble was experienced that the entire pavements were relaid, using bituminous fillers, and no further trouble developed.

There is little doubt that nearly all of the expansion trouble—certainly in every case where it was very severe—was due to the use of sand filler. Good and poor results were obtained with both light and heavy oils, and none of the trouble that has thus far occurred from expansion can in fairness be attributed to the kind of oil used.

Waterproofing Essential

It must readily be seen that, when a sand filler is used, water can penetrate the spaces between the blocks and be absorbed by the wood. This process can be retarded by creosoting the blocks, but not prevented, since creosoted wood readily absorbs water and as readily dries out. If the blocks are dry when laid and the sand filler is tightly packed, some form of buckling or expansion trouble is certain to occur during wet weather. During dry weather the blocks will dry out and shrink, the spaces between them will again become filled with tightly-packed sand, and at the next rain further expansion trouble will occur. The result is that in time the courses will be forced out of alignment and, if there is not room for further expansion, there is the possibility of bulging, displacement of the curb, and numerous other troubles. In order to prevent this it would seem absolutely essential to make the pavement waterproof.

Much less trouble was experienced with sand cushions, but sufficient could be traced to this method of construction to warrant the somewhat greater expense of the mortar cushion. This is particularly true where there are car tracks. Wherever there is considerable vibration, sand cushions are liable to shift, producing an uneven surface and permitting movement of the blocks. In case of a broken water-main or excessively heavy rain, sand is liable to be washed from beneath the blocks and result in an entire displacement of the pavement.

Shifting of Cushion

An uneven surface was found in a few cases where the blocks were laid on sand cushion and filled with bituminous filler, but this could be traced to a shifting of the cushion, due to vibration. In one case in Fort Worth, Tex., a water-main broke and washed the sand from beneath the blocks, necessitating the relaying of a considerable area. A similar accident in a location where mortar cushion was used had no effect on the pavement. Furthermore, the mortar cushion does not become saturated with water as does the sand cushion, and it affords a firm foundation for the blocks.

On a number of streets having car tracks the blocks were found to have bulged between rails, indicating that blocks laid along street railways should have ample provision for expansion and drainage, as conditions are more severe than on other sections of the pavement. Extra care should be used to see that they are not laid too tightly and that the surface is thoroughly sealed against the entrance of water. Much of the trouble noted was due to poor track construction, for it is practically impossible to lay a satisfactory wood block or any other form of pavement in street railway tracks of inferior construction.

While most of the streets inspected were from 25 to 50 feet in width, some of the cities had streets 70 feet wide. It is quite a problem to provide for expansion in such broad streets, and unless extra care is exercised, trouble is likely to develop. Several of the cities having a population of from 5,000 to 15,000 had very broad streets. It is difficult to obtain satisfactory results with wood block paving on such wide streets, and the paved area should be reduced by some provision such as parking in the centre.

It was found that the wood block pavements on streets with heavy traffic were less subject to expansion troubles than those in small cities or on light-traffic residence streets. For this reason it is not always safe to assume that the same allowance for expansion will be suitable for streets under different traffic conditions. Each case should be studied separately.

Ottawa Branch C. S. C. E.

At a special evening meeting of the Ottawa branch of the Canadian Society of Civil Engineers, held in the Carnegie Library, on the evening of February 21, Mr. F. H. Peters, a Calgary member of the society, delivered an address on "Ways and Means for Improving and Defining the Status of the Engineer."

The Calgary branch has given the question of appropriate action to define the status of the engineer a great deal of careful thought. As a result, definite resolutions urging that the whole matter be given serious consideration were recently passed and referred to the council of the society at Montreal and to the various branches. Mr. Peters explained the conclusions arrived at and the sequence of events which led to the passing of the resolutions by the Calgary branch.

In the discussion which followed, Messrs. R. deB. Corriveau, A. A. Dion, B. H. Fraser, D. MacPherson, John Murphy, R. S. Smart, and James White took part.

Ontario Surveyors Hold Annual Meeting

Committee Reports and Papers Presented at a Three Day Session of Association of Ontario Land Surveyors

The Association of Ontario Land Surveyors held their Twenty-Sixth Annual Meeting in Toronto, on February 19, 20 and 21, in the lecture room of the Engineers' Club. In consideration of the existing conditions, the convention was a very successful one. At the first session, on Tuesday morning, the meeting of the council of management was held, also the meeting of the standing and special committees. In the afternoon, after the reading of the minutes and correspondence, the president addressed the convention, and the programme proper was proceeded with. A number of interesting papers and reports were presented at this and following sessions, some of which are abstracted in our present issue. The committees submitting reports were as follows: Committee on Topographical and Exploration Surveys; Committee on Legislation; Committee on Engineering; Committee on Roads and Pavements (and moving pictures of road construction); Committee on Land Surveying; Committee on Drainage; Committee on Repository and Biography; Committee on Publication; and Committee on Entertainment. Reports were also submitted by the secretary-treasurer and auditors, the council of management and the board of examiners. The papers presented included: "Survey Monuments," by J. W. Pierce, O.L.S.; "Road Development in Ontario," by C. R. Wheelock, O.L.S.; "Problems Met with in City Surveying," by Wm. W. Perrie, O.L.S.; "Descriptions," by R. R. Grant, O.L.S.; "Smooth Rock Water Power Development on Mattagami River" by E. W. Neelands, O.L.S.; "New System of Surveys in Western Canada," by J. K. Benner, O.L.S.; "Development in Northern Ontario," by J. F. Whitson, O.L.S. H. S. VanScoyoc, chief engineer, Toronto & Hamilton Highway Commission, gave the members an interesting talk on this well-known road. Another interesting feature of the programme was the discussion on "Town Planning Act," opened by Mr. T. D. LeMay, O.L.S. Mr. Owen McKay, O.L.S., also presented an illustration of the town plan of Ojibway.

The election of officers for 1918 resulted as follows: President, Herbert J. Beatty, Pembroke; vice-president, C. Fraser Aylsworth, Madoc; secretary-treasurer, L. V. Rorke, Toronto.

Report of Committee on Roads and Pavements

During the past year good progress was made in the improvement of roads througout the province. The tendency has been to complete the program of construction of main roads decided on before the war and provide a system of maintenance for such other roads, which are now under consideration for improvement. Labor conditions have been such that much work has been difficult to complete, and all costs have been higher.

The counties have found the Ontario Highway Improvement Act so attractive than ten adopted a good roads by-law this year, so that there are only three counties not in the system to-day.

On April 10, 1917, the act to create a system of provincial highways was proclaimed, and, in accordance with this act, a provincial highway has been assured in the Counties of Ontario and Durham.

The Toronto-Hamilton Highway was officially opened on November 24, 1917. The completion of this road should aid greatly in the development of the splendid agricultural country between those two cities.

Dundas Street westerly from the Toronto city line has been paved for a distance of approximately three and three-quarter miles to the York County line at Etobicoke Creek.

Development in the North

The Northern development branch has been active, and during the season completed the International Highway, between Port Arthur and the Pigeon River, on international boundary, a distance of about 50 miles, so that there is now access to Duluth, Superior City, and other cities in Northern Minnesota by automobile from Port Arthur.

The trunk road, 80 miles in length, between North Bay and Sudbury was also opened up for automobile traffic last October. The road has been surfaced partly with crushed rock and gravel.

In the District of Rainy River a trunk road has been completed between Fort Frances and the town of Rainy River, and it is now possible to reach the city of Winnipeg and towns in Northern Minnesota from Fort Frances.

A trunk road between Sault Ste. Marie and Algoma Mills, 100 miles in length, has been completed, having been surfaced with rock or gravel throughout the entire distance.

The North Bay and Bracebridge trunk road has been completed from North Bay to Sundridge, a distance of 50 miles.

Along the Canadian Pacific Railway, east and west of the town of Dryden, on the main line, a trunk road was laid out last season and about 10 miles of it constructed.

Considerable work has been done in building macadam roads from the town of Sudbury into the different mining camps in that district.

During the season 10 miles of road were resurfaced with crushed rock and 125 miles resurfaced with gravel, while many short roads were opened up and improved, into farming sections.

The curtailment of programs of road construction and maintenance has been marked, but this now appears to be viewed as false economy, and more liberal treatment of maintenance problems is probable.

Types of Survey Monuments

Wooden Posts, Trees, and Iron Bars Mark Locations under Various Conditions — Efforts at Standardization

By J. W. Pierce, O. L. S.

A MONUMENT has been defined as an object, whether natural or artificial, fixed in the soil, and referred to in a document, and used as evidence for the delineation of boundaries or the situation of a particular plot of land.

Until comparatively recently on ordinary land surveys in this province, the wooden post or a tree marked for a post has been used exclusively, due to the readiness with which posts of this material may be everywhere procured, and to the ease with which they may be set in place. Monuments of this class, when made of proper material and firmly planted, are without doubt very satisfactory for a short time after erection; they are readily located and easily interpreted, and if they were only more permanent, they would be ideal.

In some of the foreign countries, and in fact in some of the earlier surveys in provinces in this country, it was customary to bury pieces of crockery, glass or other permanent material under the post, and in this connection we find the following instruction in the United States Manual of 1871,—"Besides the charcoal, marked stone, or charred stake, one or the other of which must be lodged in the earth at the point of the corner, the deputy surveyor is recommended to plant midway between each pit and the trench, seeds of some tree (those of fruit trees adapted to the climate always to be preferred), so that in course of time, should such take root, a small clump of trees may possibly hereafter note the place of the corner. The fact of planting such seed and the kind thereof are matters to be truthfully noted in the field book."

Township or Section Corners

So far as I am aware, it has never been the custom in this province to perpetuate monuments in the manner just referred to, although from a very early date our surveyors have recognized the necessity of doing more than merely planting a single wooden post. For years the position of a post has been referenced by means of bearing trees. In a great many cases surveyors have gathered stones and boulders and built a mound around the post. In other cases the old maxim, "that there is safety in numbers," has been called into use, and instead of one post, three are planted at lot corners, and five at the intersection of road allowances. Indeed, in some cases, surveyors were unable to limit themselves to five posts—an examination of some of the original notes reveals the fact that in certain townships three rows of three posts, or nine in all, were planted at these intersections. In our present nine-mile township this system of posting is still in use, and in cases where the road allowance along a river or lake intersects the intersection of a concession and side road, you have your day's work right there. In many of these cases, our most experienced surveyors are unable to agree among themselves just where posting should be stopped and how some of these posts should be marked, and when we consider that these posts are often put in place by chainmen who are not always infallible, it is occasionally a source of speculation as to whether this method of posting is the best and most efficient that could be evolved.

The disastrous effect of forest fires has been recognized to the extent that, in our later surveys in Northern Ontario, surveyors have been supplied with supplementary iron posts which are planted at stated intervals throughout the township, such as the corners of a three-mile block, but no step, except a legal measure, has been taken to safeguard the post from loss through wilful removal or tampering through idle curiosity.

Iron Bar Monuments Suit Prairie Conditions

Until recently subdivision surveys have been carried on in the provinces of Manitoba, Saskatchewan and Alberta under conditions entirely different to those obtaining in Ontario, and the method of posting has necessarily also been different. Over a great portion of the West, it was impossible to obtain material to make wooden posts such as ours, and various types of monuments have been in use, the most common being the iron bar set midway between four pits; or in bush, the iron bar at the north corner of a mound, five feet square, the mound itself being midway between four pits, each three feet square and eighteen inches deep. The iron posts used weighed about three pounds each, of piping 2 ft. 6 in. in length, pointed at one end and squared at the other, on which the marks were made with a cold chisel. It might be noted here that no lines are surveyed in the centre of a road allowance, but always along the side, and that one row of posts only is erected. Thus, instead of planting a post at the angle of every parcel of land separated by a road allowance, one post only is planted, and the other corners located from it.

During the first year of the war the Surveyor-General of Dominion Lands carried on correspondence with the Commissioner of the General Land Office at Washington, and also asked the various Land Surveyors then employed for their suggestions and criticisms, which has resulted in the adoption of a new model iron post for Dominion Land Surveys based on that used in surveys of the public lands of the United States.

Standard Post for Dominion Land Surveys

This post consists of standard wrought iron pipe one inch in diameter, thirty inches in length, to the top of which is fastened a bronze cap three inches in diameter. The cap has, in the latest model, a cast-iron cone inserted in it, and the end of the pipe is forced into the annular space between the cone and the cap, forming a very tight fit. The composition of the cap is ninety parts copper, five parts tin, four parts zinc and one part lead. A malleable iron foot-plate, three and one-half inches in diameter, with a hole smaller than the diameter, is forced over the other end of the pipe, which has just received six equally spaced saw-cuts, after which the cut parts are bent down, thus insuring that the foot plate will neither move up or down along the post. The whole post then receives a protective coating by being dipped into a vat of asphaltum, after which the pipe is compactly filled with a cement mortar consisting of equal parts of portland cement and sand. After the cement is set, the face of the bronze cap is cleaned off with gasoline.

These posts weigh about eight pounds and are packed in basswood crates, ten to a crate, the total crate weighing eighty-five pounds. They cost the government last year $11.10 a crate, f.o.b. Winnipeg, or $1.11 each. Two years ago they cost around 70 cents each.

Method of Location

In planting it is necessary to dig a hole thirty inches deep to receive the post, after which the earth is tamped back around the post so that the bronze cap only is exposed and is flush with the surface of the ground. The post is placed midway between four pits and in bush country the earth from the pits is formed into a mound. Various methods are in use for planting the post. In soil free from stone or frost, the ordinary post-hole auger is satisfactory, but in ordinary bush country, where roots, stones and frost are encountered, in addition to greater difficulty in regard to transportation, an iron bar and the spade are most satisfactory.

The bronze cap comes with the inscription of Dominion Lands Surveys, the penalty for the removal, and the Crown, in addition to a centre mark, and the chainmen are supplied with a set of seventeen dies in a leather belt, similar to a cartridge belt, which are used to stamp on the section number, township, range and date. Under ordinary conditions a party of two mounders will erect from four to six of these mounds per day.

In rock country, where the rock is at the surface or within twelve inches of the surface, a special post is used. This post is entirely of bronze, the top being identical with that of the standard post from which a seven-eighths inch shank projects for three inches, the weight being under a pound. In planting this post a hole is drilled in the rock three inches in depth and filled with a paste composed of a mixture of portland cement and water, into which the post is pressed. The necessary cement is supplied in small water-tight tins, and special drills are used. The drills are well suited to the purpose; they are light and will stand for two or three holes in the very hardest of granite.

Advantages of D.L.S. Monument

The advantages of this type of monument are so apparent as to scarcely need enumeration—the principal points being increased permanence and greater uniformity of practice among surveyors in erecting monuments. After the post is in place, it is almost impossible to remove it, except by digging, and it is also inconspicuous. It does not invite needless attention; in fact, nine out of ten persons in passing these monuments will, while they at once notice the pits and mound, pass the post, unless they have occasion to look for it in particular. When, however, it is necessary to locate the exact corner, one may approach the corner with every assurance that the post is in place.

When this model of post was first introduced, it occasioned serious misgivings in the minds of the Dominion Land Surveyors as to its practicability, and considerable speculation was indulged in, particularly with regard to its weight, extra transportation necessary, difficulties likely to be encountered in its installation and increase in labor. Now, after three years of successful operation, it is apparent that these fears were to a great extent groundless, and it is safe to say that, with ordinary conditions, the additional extra help necessary on a survey party due to the change in the type of monument does not amount to more than one man. The Dominion Land Surveyors have heartily endorsed this post, and it is very questionable whether there are any among their number who would voluntarily return to the old type in use.

Road Development in Ontario

Classification of Highways According to Present Legislation—Progressive Development and Continuous Development

By C. R. Wheelock, O. L. S.

THE roads of Old or South Ontario have developed from bush trails and portages to the present state. Traffic was originally confined to the waterways, and gradually trails were opened up over portages between navigable streams and lakes. Food and material used by the natives and early settlers were carried over these trails. Year by year the main trails were extended and improved, and eventually resulted in some of our main through highways, such as Dundas Street from Toronto to Dundas, which was in early days the head of navigation for South-western Ontario; and that the Dundas Road was laid out before any surveys were made is evident from the wandering route that it takes. Other examples may be found in the famous Talbot Road, from Niagara Falls to Windsor; Hurontario Street, and the Toronto and Sydenham Road, from Port Credit to Owen Sound, and the Kingston Road, running east from Toronto through Kingston, Cornwall, and Prescott to the Quebec boundary.

As traffic increased the trails were gradually widened and horses and carts introduced to provide transportation for heavier loads. It was then rendered necessary to make passable roads through the soft places in swamps and low-lying lands, and an attempt was made to pave such places with logs. The logs were of variable size, laid on an uneven bottom, and the result was a most uneven surface. Many miles of this type of road were afterwards built, known as corduroy.

Dundas Street Continuously Improved

Many of the main through roads of the province were surveyed in the last decade of the eighteenth century. Dundas Street, previously referred to, was surveyed about the year 1792, but was not bridged and fully completed for traffic until after the war of 1812, although the work of consrruction had been commenced some years previous to this time. This road adjoining Toronto may be taken as a concrete example of the development of our main roads. As stated before, it was originally a bush trail, afterwards surveyed and opened up as a main highway. The surface was built of broken stone and gravel. For years this had been added to as occasion demanded. Some years ago, to meet the increased traffic, a portion was resurfaced with waterbound macadam, and a few years later the traffic became so intense it was necessary to apply a bituminous coating. A further increase in the volume of traffic has rendered that form of surface inadequate, and last year a bituminous surface known as asphaltic concrete, similar to that used on some of the well-known streets of Toronto, was constructed.

Progressive Legislation

The first highway legislation of Upper Canada, enacted in 1793, authorizing justices of the peace to be highway commissioners, led to what is generally known as "statute labor." The statute labor law provided a means of opening the original roads of this country when money was scarce and settlers few; and, although it was not without its limitations, it solved most of the problems of land transportation for the greater part of the last century. The system has since outgrown its usefulness, and in 75 of the most prosperous townships in the province statute labor has been entirely abolished. For the 25 years or so following the year 1830, under the toll road system, many roads and bridges were developed. Although legislation was enacted at various times, a satisfactory solution of the toll road question was not reached until the Highway Improvement Act was passed, in 1901. This was the result of agitation for improved roads carried on by the Good Roads Association. The organization of this association in 1894 was a result of a general agitation in favor of counties assuming the responsibility for the construction and maintenance of main market roads and for larger expenditures for highway improvement. Amendments have been made to the Highway Improvement Act from time to time, and it has been supplemented by the Ontario Highways Act of 1915-16 and the Provincial Highway Act of 1917.

The classification and description of roads under the above acts, taken from the department's last report, are as follows:

County Roads

These roads are essentially the market roads—the farmers' roads. They radiate from market towns and shipping points, and meet the needs of accumulated farm traffic. The aiding of these market roads by the province is an effective means of assisting townships in their road improvement, in that township councils are thereby relieved from the burden of their most expensive roads, and can devote their energies to the improvement of less travelled roads, comparatively inexpensive to maintain. County roads are aided to the extent of 40 per cent. for construction and 20 per cent. for maintenance. All county councils are authorized, under the Highway Improvement Act, to assume and control a system of leading roads within the county.

Provincial County Roads

Co-operative with provincial roads, but under county control, certain roads may be designated by the Highways Department as "provincial county roads." To such roads the province will contribute 60 per cent. of the cost of construction and maintenance. These roads are intended to enable the more equitable maintenance of certain county roads, carrying a considerable portion of through traffic, but which the county may efficiently maintain, and which are not of sufficient importance to be classed as provincial, or which it is not desirable or expedient for the province to assume as provincial highways. They continue to be county roads, but because of heavy through traffic will receive an increased subsidy. In general, they will form branches of the provincial highway system, joining up cities and other important terminal points of traffic. They constitute an intermediate link between the provincial and county road systems, and may be subject to special regulation.

Suburban Roads

Provision is made under the Ontario Highways Act that a city may co-operate with the county council in improving the leading county roads adjacent to the city, and thereby obtain a more substantial type of construction for such suburban roads. A commission is appointed to determine the roads and the length of each adjacent to the city to which the city would contribute. For construction the province contributes 40 per cent. and the county and city each 30 per cent.; for maintenance and repair the province 20 per cent. and the county and city divide the remainder equally between them. The section of county road designated as "suburban" remains a county road, for which the county is responsible, the work of construction and maintenance to be carried on under the county road superintendent, but subject to the instructions of the special commission.

Provincial Highways

Provincial highways are described in the preamble to the act as: "A highway or system of highways from the southwestern boundary of Ontario to the boundary line between Ontario and Quebec, together with highways connecting centres of population or other important terminal points."

The Lieutenant-Governor-in-Council, upon recommendation of the minister, may designate any highway or a system of public highways through Ontario to be acquired, constructed, assumed, repaired, relocated, deviated, widened, and maintained by the Minister of Highways as a provincial highway.

Every provincial highway and all property acquired by Ontario under this act shall be vested in His Majesty, and shall be under the control of the department.

The corporation of every municipality in which work of construction or repair and maintenance is from time to time carried out shall repay to Ontario 30 per cent. of the expenditure made by the department within such municipality.

No part of the cost of surveys, of machinery, plant, and equipment, and the repair and maintenance thereof, all general overhead and staff expenses and salaries, and the cost of additional land or property for deviating, widening, or any other purposes of the department, shall be charged to the municipality, but shall be borne and carried by Ontario.

Counties Taking Up the Work Systematically

Up to the year 1916 only 20 counties had assumed systems of county roads as authorized under the Highway Improvement Act; now 34 counties out of the 37 in Old Ontario have adopted such systems and are proceeding with the work in a systematic manner, under the regulations of the department. The total mileage covered by these roads is 8,427, and the total mileage construction to date 2,275, the total approximate cost being $8,600,000, an average of $3,780 a mile. As the total mileage of rural roads in Old Ontario is 55,000, the mileage covered by county roads at the present time is 15 per cent. of the total. It is estimated by the Highway Department that 20 per cent. of the township roads, those usually included in a county system, carry 80 per cent. of the total farm traffic.

The county roads, when completed, will form an excellent system of market roads located in every part of the province. The provincial county roads will join up these county systems for through traffic, and will merge the whole into a provincial-wide system, reaching every county and town in the province, and to complete this system trunk roads will be added, known as provincial highways, for trans-provincial traffic. This will create a system of provincial highways which will not have an equal in any province or state on the continent.

Road construction has been greatly retarded owing to war conditions, but, as stated above, over 2,000 miles of this system has already been built. The organization is complete and the work will go ahead with leaps and bounds when the war is over.

In conclusion, a few words respecting road construction. The day for haphazard work by untrained men is past. The road problems of to-day require to be carefully worked out by the expert and the correct principles applied. A bridge is never designed without knowing the particulars as to loading, etc., and in the days of heavily-loaded motor trucks it is also necessary, if we are to intelligently design our roads and get the best results, to take into consideration such particulars as the maximum load, width of vehicles, width of tires, nature of traffic, nature of sub-soil, etc. The maximum load is the chief factor in determining the depth of foundation, and a road built for light traffic may at certain times in the year have its surface broken up by a heavily-loaded truck.

Robb Engineering Works, Limited

The name of the "International Engineering Works, Limited," has been changed to "Robb Engineering Works, Limited," the organization of the company remaining the same. The object of the change is stated to be a desire to identify the business with its past history and reputation as manufacturers of Robb engines, boilers, and other products so well known to the engineering profession.

Mr. Ross H. McMaster, director and manager of the Steel Company of Canada, Montreal, has been appointed buyer of steel for Canada for the Imperial War Board in the United States.

Scheme to Prevent Trouble from Spring Flooding at Regina

THE situation with regard to the flooding of certain portions of the city at the spring break-up of the Wascana River was discussed at a recent meeting of a committee of the Regina City Council, when City Engineer McCannel outlined a scheme for obviating this trouble. The cause of the flooding, he states, is due to the fact that the reservoir is too small to afford any relief as a storage basin, the area of the basin with water at flood level being only 8 square miles, while the watershed is approximately 250 square miles.

It was pointed out that partial opening of the sluice-gates in the Albert Street dam by the provincial government last spring for some days immediately prior to the flood cleared the channel in the creek bed below the dam for the heavy flow of water which was to follow, and Mr. McCannel expressed the opinion that this would have an ameliorating effect during some seasons. His scheme for permanent improvement was outlined in the report as follows:

"As a means of providing relief, in addition to the opening of the sluice-gates as mentioned, I have considered the question of straightening and enlarging the channel from Albert to Dewdney Street, which I believe to be the method of remedying the trouble. The following costs of constructing this proposed channel are based on the available information which would require to be greatly augmented by additional surveys before a definite figure could be submitted. I wish to point out further in this connection that at present there is under consideration a proposal for a drainage scheme comprising an area of approximately 20,000 acres near the source of Wascana Creek, and if this or similar drainage schemes are undertaken, the volume of water to be taken care of at flood time will be increased above the maximum flow of 1916."

Estimate of Cost

Total length of proposed channel, Albert to Dewdney St., 15,670 ft.; cross section, 450 sq. ft.	$60,347.00
Rebuilding bridges	10,000.00
Damages to private property, 140 25-ft. lots at $150 each	21,000.00
	$91,347.00
Engineering and debenture costs, 15 per cent.	13,702.05
Total cost	$105,049.05

In view of existing circumstances, the committee did not feel justified in authorizing so large an expenditure at the present time, but they instructed the city commissioners to bring in a report dealing with the situation as a temporary measure. This action was taken on the suggestion of one of the members that there were some minor obstructions, the removal of which might to some extent alleviate the situation this spring. Their decision was further influenced by the statement of City Commisioner Thornton that, even if Mr. McCannel's project were carried, he was doubtful if it would guarantee immunity from flooding conditions, as there was always the danger of the water backing up from the flats in the vicinity of the sewage disposal works below the city, no matter what scheme of improvement was undertaken.

Fuel Situation in War Time

Address Before Canadian Railway Club Emphasizes Wastefulness from Overheat—Railways Doing their Share

By Mr. T. Britt*

NEVER in the history of the world has coal been of such vital importance. It is the life-blood of the nations engaged in this unfortunate world-wide war, and the success of the allies is very largely dependent upon its increased production and careful conservation.

It was customary in former years to send the surplus coal produced in Eastern Canada to the New England States and from Western Canada to the Western States, Central Canada and that part west of the Great Lakes and as far as Brandon being supplied with American coal. The total production of Canadian coal prior to the war was 15,000,000 tons per annum, and in the United States between 500,000,000 and 600,000,000, the latter being the production for 1916. During the year 1917 Canada will produce nearly 2,000,000 tons less, and the United States approximately 50,000,000 tons more, than in 1916. But as the increase in consumption is approximately 100,000,000 tons, there is a shortage of 50,000,000 tons to be made up by elimination of wastage.

Present Distribution System Economically Arranged

Sending Eastern and Western Canadian coal to the United States and American coal to Central and part of Western Canada was with the object of sending coals by the most suitable rail traffic routes and waterways and providing more even distribution. If Eastern Canadian coal was moved west it would be against the current of traffic to Fort William, and if Western Canadian coal was moved to Eastern Canada it would put onto railroads the burden of transporting the longest distance on the American Continent.

The United States Government has been very considerate towards Canada, and will continue to be so, the intention being to treat Canada on an equality with any state in the Union, but, while doing this, they expect and insist that we do the same as they are doing, viz., inaugurate a campaign for the intensive conservation of fuel.

It is not the purpose of this paper to point out in what way our share of the deficiency is to be made up, it being principally a matter of good engineering and true fuel conservation in the boiler-room.

Railways Reducing Consumption

Canadian railways have already reduced their annual passenger train mileage by 10,000,000 miles, and have further decreased the fuel consumption by lengthening out the times of other trains and by eliminating fast freights and, instead, running trains with full tonnage, and by equipping locomotives with superheaters and the best-known modern means of lessening fuel consumption. The Canadian Pacific Railway has been helping the cause by breaking up and using old ties for fuel—this even at considerable expense of labor, train service, etc., gathering and handling. The United States have also made a start in reducing their passenger service and loading their trains to the tonnage limit, thereby affecting a saving of several million tons of coal per annum.

I think that we should go further and inaugurate an active educational campaign among the firemen, both locomotive and boiler-house men. To my mind, this should not be done by printed instructions, but by actual illustration by competent firemen. While it is all very well to write a fireman and tell him what he should do, it is far more educational for a competent instructor to show how it should and could be done.

There is a lot of fuel wasted by automatic stokers not receiving intelligent attention from the fireman. The stoker itself, when in proper working order, will do all that is required of it, but there are, however, occasions when it will not do what it is supposed to. It is then that a properly-instructed fireman will give necessary assistance, with a consequent saving in fuel.

Overheat Is a Waste of Fuel

The majority of our passenger trains, particularly the sleeping cars, are overheated, it being largely left to the discretion of the colored porter as to what is considered a comfortable temperature. The result is that the temperature is kept up to a point that means comfort for the porter and discomfort for the passengers.

Our houses are being maintained at an unhealthy temperature. Pneumonia takes a little more than one man in eight, and therefore it grasps from tuberculosis the grim honor of killing the most human beings. Man is a marine animal; seven-eighths water, he needs cool air and moisture around him. Overheated, dry air makes him susceptible to disease, and in a temperature of over 68 degrees it is difficult for men and women to exist healthfully. If the people can be taught to live in this temperature the number of pneumonia victims will shortly decrease. Fresh, cool, moist air is the foe of pneumonia, and persons who keep their houses cool and breathe pure, fresh air have no fear of it. Celebrated doctors have decided that 65 degrees is ample for persons in robust health actively engaged; 70 is too much; with 68 we have a fair, healthy average.

Industrial Economy

Many activities which involve large consumption of fuel and many methods of using this fuel, which are practically legitimate in time of peace, will be found susceptible of changes which involve very slight sacrifices of material interests but afford opportunities for considerable saving of fuel.

We have in the past been an extravagant people in the use of fuel, and as the war continues it will be necessary to get down to bedrock in the matter of fuel economy. Manufacturers of non-essentials should during these war times voluntarily forego the manufacture of such articles before being compelled to do so by government direction. Wherever possible water-power should be utilized. In wooded districts, of which there are several in Canada, wood should be utilized wherever possible. One cord of hardwood is equal to one ton of coal, and one ton of coal is released for use in war work for every cord of wood substituted. It will be found that there is a vast quantity of dead wood in many sections of the country. It will also be found that the supply of wood in many communities is sufficient for domestic purposes in these parts. This wood in many instances is destroyed as waste, and its conservation will not only serve the patriotic purpose of conserving coal needed to win the war, but will also prove a measure of economy to the user. In certain districts prison labor might be used as a means of cutting and collecting wood, where, of course, the labor of the prisoners could be utilized without interference with free labor.

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* General Fuel Agent, Canadian Pacific Railway, Montreal.

As a matter of fact, the one practical and needful thing to-day is to save coal in order that our transportation lines and munition plants may have sufficient to carry on. It may be patriotic and a certain amount of pleasure may be derived from singing "Keep the Home Fires Burning," but the saving of one ton of coal is of more practical benefit towards assisting the boys in the trenches than the singing of one hundred songs.

Advantages and Construction Requirements of Concrete Pressure Pipe

A BULLETIN issued by the Portland Cement Association contains suggestions regarding reinforced concrete pressure pipe. The advantages which are claimed for such pipe and construction requirements are mentioned in thispamphlet as follows:

Reinforced concrete pipe is always ready to serve its intended purpose with full efficiency. It will not dry out, rot, rust, or burn. These advantages are important, because the pipe suffers no impairment either in use or when not in use. Properly made, it will not leak.

Such pipe may be used under any pressure to which water pipe is usually subjected. Concrete pipe have been successfully used under heads considerably greater than 100 feet. Reinforced concrete pipe has the strength necessary to resist external pressure of the earth at any depth to which it is practicable to place it; also the strength to resist any internal pressure to which commonly subjected. It permits of any desired alignment. Such curves as may be necessary either to conform to contour of the ground or to avoid obstructions can readily be introduced, and without in any way affecting watertightness of the pipe line. The inner surface of concrete pipe is smooth and uniform, so the friction of flow is slight.

Reinforced concrete pipe lines are giving equally satisfactory service in the extreme heat of Mexico and in the severe cold of Northern Canada.

Conditions Favorable to Use

War is making such demands for plate steel and iron as to restrict the availability of these materials for most other uses. Steel in the form of rods or mesh required to reinforce concrete pipe is usually readily obtainable. In addition, the bulk of the materials of which concrete pressure pipe are made can usually be obtained either on the site or near the work. This makes it unnecessary to transport any considerable quantity of materials; thus our present overtaxed transportation facilities are not further burdened.

Many large cities in the United States and Canada are using reinforced concrete pressure pipe in all sizes from 36 to 108 inches in diameter, under a wide range of pressure conditions for water supply mains. The United States Government is using it in connection with irrigation projects. Power companies are using it to convey water for power purposes. It is adapted to practically all conditions of service imposed by municipal water supply, irrigation, or power requirements.

Construction Requirements

Manufacturing requirements involve properly graded aggregates, properly proportioned, mixed, and placed. Proportions of the concrete mixture should be 1:1½:2½. This means 1 sack of portland cement to 1½ cubic feet of well-graded, clean sand, to 2½ cubic feet of clean, well-graded pebbles or broken stone ranging from ¼ to not exceeding ¾ inch in greatest dimension. This will ensure watertight pipe. After concrete has been properly mixed and placed, the finished pipe must be protected to prevent rapid drying out of the concrete—in other words, to prevent loss of any of the water used in mixing, so that the concrete may harden normally in the presence of moisture. Steam curing of pipe is certain to produce a better and more nearly uniform product.

If for any reason steam curing of pipe is not practicable, the pipe should be protected from rapid drying by some suitable covering, which must be kept wet daily for two weeks after the pipe have been formed. They can then be allowed to acquire additional strength in the storage yard until thirty days old.

Strength is secured by embedding proper reinforcing in the concrete when placed. Steel bars, or cold-drawn wire mesh, may be used. Working stresses for the former should be 10,000 pounds per square inch and for the latter 12,000 pounds.

Steel Bridge Construction in Quebec

In a recent report of the Minister of Public Works of the Province of Quebec it is stated that the building of iron bridges has not been less active during the calendar year 1917 than in previous years. The report submitted by the chief engineer gives the number of bridges built and those being built as follows:

Number of bridges built to June 30, 1917	427
Number of bridges being in course of construction	54
Cost of bridges built up to June 30, 1917	$2,873,657.76
Cost of bridges under construction	$481,703.00
Number of new requests for bridges nearly	200
Plans of bridges prepared during the year	84
Plans of bridges being studied, June 30, 1917	69

The number of plans of bridges prepared during the year is smaller than that of the preceding year, but, on the other hand, a certain number of plans, by reason of the locality, change of site, or the importance of the bridge, have necessitated a longer study.

Canada Cement Company Report Increase in Revenue

The Canada Cement Company report a large increase in revenue for 1917. After writing off $2,190,616 for depreciation and special equipment, the net earnings totalled $2,861,246, a gain of $642,398, and, after providing for fixed charges, dividends, and reserves, the sum of $484,181 is carried forward. Senator Edwards, the president, states that "the demand for your company's product during the past year was approximately the same as the two preceding years, notwithstanding the fact that work on many large and important projects was suspended. The constsantly increasing employment of cement for all purposes, especially by farmers and small users, has enabled the company to do a volume of business the result of which we think will be satisfactory to you." The earnings from the cement business, he adds, were more than sufficient to take care of all fixed charges, preferred and ordinary dividends chargeable to the year's profits. The volume of cement business for 1918 should be practically the same as in 1917.

Carbonizing and Briquetting of Lignites in Saskatchewan

EVER since the organization of the Commission of Conservation, in 1910, the utilization of the lignites of the Prairie Provinces has received attention. The commission early realized that the solution of this problem would overcome the fuel difficulty of these provinces, and also promote the industrial development of those portions which are without water-power resources.

At the annual meeting of the commission in 1912 the Committee on Minerals recommended that:

"Owing to the necessity of obtaining a suitable domestic fuel and cheap power for the Prairie Provinces, it is desirable that investigations be carried on with a view to utilizing the lignites which underlie the greater portion of these provinces."

The recommendation also pointed out that the United States Bureau of Mines had demonstrated that low-grade lignites could be briquetted, and adverted to the fact that Germany utilized her brown coal or lignite deposits by briquetting, producing in 1910 some 21,575,000 short tons of briquettes, of which 77 per cent. was made from lignites.

In harmony with this recommendation, Mr. W. J. Dick, as mining engineer of the commission, visited the lignite fields of Western Canada in 1912 and 1913 and investigated the problem. The report discussed in detail the supply, quality, and method of treatment of the Western lignites necessary to render them serviceable as a fuel, both for domestic and power purposes.

It was probably these early investigations of the Commission of Conservation that prompted the Advisory Council for Scientific and Industrial Research, when it took up the fuel problem of Western Canada immediately after its formation in 1916, to apply to the commission for information on the subject. The report which follows is the result. It deals mostly with the economic side of the problem, and is largely a summary of portions of the information gathered in 1912 and 1913 brought up to date after Mr. Dick had again visited the Prairie Provinces in 1917 for further investigation of the fuel situation.

The General Fuel Situation

The producing coal fields of Canada are situated in the eastern and western portions of the Dominion. Owing to economic conditions, the interior portion, from Cornwall on the east to Swift Current on the west, is supplied by coal from the United States, Central and Eastern Ontario being supplied via St. Lawrence, Lake Ontario, and Niagara River ports, while that for the West is shipped by rail to Buffalo and other Lake Erie ports, whence it is carried by water and rail to its destination. Bituminous coal is used principally for railway purposes and anthracite for domestic use.

In so far as supplies of fuel are concerned, the eastern portion of Saskatchewan forms the competitive area between supplies of United States coal on the one hand and of the high-grade bituminous coal of the Rocky Mountains on the other. Owing to this fact, the cost of fuel in this portion of the province is high. The southern half of Saskatchewan has been considerably developed, and forms to-day the most important portion; but there are no water-powers within this area that could be utilized as a source of cheap power for the most important cities. The central and southern portions of the province receive little precipitation, and consequently have no large rivers; such creeks and lakes as are found do not even provide water suitable for domestic purposes. This area, however, is situated in proximity to large deposits of lignite coal.

High Price for Anthracite

In 1916, 533,642 tons of anthracite coal and 2,376,934 tons of bituminous coal were imported via Port Arthur, Fort William, and Manitoba ports of entry. At least four-fifths of the anthracite was used as a domestic fuel in Manitoba and Saskatchewan. The imports of anthracite have been increasing, notwithstanding its increase in price. If mined at the present rate of production, the anthracite coal reserves of the United States will be exhausted in about 100 years. It must, therefore, be expected that the price will gradually increase until only the wealthy can afford it. Coincidently with the rising price production will decrease, thus prolonging the life of the mines.

This situation is unique, and the high price paid for anthracite coal has not a parallel elsewhere. In other countries, even where coal is cheaper than in Canada, substitutes have been developed. In 1917 the price of anthracite coal in the West varied from $12 per ton at Winnipeg to $14.50 in Moose Jaw. It is desirable, both from mining and national standpoints, that these conditions be changed. It is inconceivable what would happen if the exportation of hard and soft coal from the United States were prohibited. We had, in the spring of 1917, a slight indication of what it would mean, when a freight blockade caused a temporary shortage in some localities.

It is thus evident that, before many years, Western Canada will not be able to procure supplies of anthracite from the United States. As there are no supplies of this class of coal suitably situated in Canada, some kind of a substitute must be found. Briquetted lignite is the one most easily available.

Utilizing Low-Grade Fuels

The problems to be dealt with in the Provinces of Manitoba and Saskatchewan are those of domestic fuel and cheap power. These may be solved by the proper utilization of the low-grade fuels which underlie a portion of Saskatchewan. In order to make this coal transportable and suitable for domestic and power purposes it would be necessary:

1. That it be of sufficient value to bear the cost of transportation.
2. That it withstand handling and a certain amount of weathering.
3. That it be a suitable fuel for domestic and power purposes.

Coal or lignite briquettes and carbonized lignite briquettes fulfil these conditions.

Raw lignite is heated in closed retorts, somewhat similar to by-product coke ovens. The volatile matter and moisture is driven off in the form of gas, a portion of which may be used for heating the retort and the remainder recovered as a by-product. The carbonized material, unlike bituminous coke, is hard, dense, and incoherent, consisting chiefly of slack. When briquetted, it produces a fuel similar in many respects to anthracite coal.

Coal Available for a Briquetting Plant in the Souris District

On account of the nature of the coal and its proximity and transportation facilities to suitable markets, the best location in Saskatchewan for such a plant would, no doubt, be in the Estevan district.

A plant with a capacity for briquetting 10 tons per hour is proposed, but it is the intention to operate the briquetting division half-time only, until the plant is proven. Although the plant is capable of producing double this tonnage, the estimated cost of producing briquettes is based on half the capacity of the briquetting plant only. It will operate on carbonized lignite, and as two tons of raw lignite are required to produce one ton of briquettes, the amount of coal required annually is 60,000 tons. The principal producing mines in the Estevan district are:

	Production in 1916. Tons.
Western Dominion Collieries	91,843
Manitoba and Saskatchewan Coal Company	67,809
Bienfait Mine (Hosmer Mine)	36,452
Saskatchewan Coal, Brick, and Power Company (Shand Mine)	23,755

As there is, practically, no market for lignite slack, the coal is loaded into cars in the mine by means of forks, the fine coal being left behind. On account of the rapid disintegration of lignite, the product from the mine is screened on the surface and the slack wasted. In this way from 1 to 20 per cent. or more of that mined is wasted. This waste in mines of the Bienfait district amounts to from 30,000 to 35,000 tons per annum.

Cost of Mining

If the demand for coal were such that the mines could work up to capacity throughout the year, the cost of production would be less than at present, but there would be other disadvantages.

The cost of producing one ton of saleable lignite is estimated at from $1.25 to $1.50, depending on the mine, plant equipment, etc. If all the coal mined were saleable, it is estimated that the cost of production would vary from $1.14 to $1.41 per ton. The slack coal now wasted could be obtained at from 50 cents to 75 cents per ton.

Summary

1. The requirements of the proposed carbonizing plant are 60,000 tons per year.

2. From 30,000 to 35,000 tons of slack coal could be obtained annually at Bienfait, at a cost of 75c per ton; 5,000 tons at Shand station, at about 60c per ton, whilst 20,000 tons could be obtained under certain conditions from Estevan at 50c per ton.

30,000 tons at 75c per ton	$22,500
5,000 tons at 60c per ton	3,000
20,000 tons at 50c per ton	10,000
55,000 tons at a total cost of	$35,000

Average cost per ton of slack at mines=65c.

In this district there is sufficient slack made in mining operations to supply a plant of the size proposed. On account of the slack being produced principally in the autumn and winter months, and, as it cannot be stored, there would not be a steady supply of this material to keep the plant in continuous operation. On the other hand, there would be a large enough supply for about half of the time, and at a period when the mines would be glad to sell it; for the remainder, run-of-mine coal could be obtained at a price of $1.50 per ton.

Location of Carbonizing and Briquetting Plant

The economic selection of a location in Saskatchewan for the carbonizing and briquetting plant is determined by the following:

1. Suitable supply of cheap coal near plant.
2. Transportation facilities by which the briquetted material may be delivered to the most profitable markets at a minimum cost due to freight charges.
3. A consideration of markets for by-products, such as gas, resulting from carbonization of the lignite.

Supply of Coal.—The only developed mines which could deliver adequate supplies of coal are the Western Dominion Collieries, Manitoba and Saskatchewan Coal Company, Bienfait Mine, Shand Mine, Estevan Coal and Brick Company. All these mines are in the vicinity of the town of Estevan.

Transportation Facilities.—Either Estevan or Bienfait presents exceptional advantages for serving the larger markets of Saskatchewan and Manitoba.

Markets for By-products.—The most important by-product recovered during carbonization is gas. From every ton of lignite carbonized there is a surplus of 4,000 cubic feet of gas, with a heat value of 400 to 450 B.T.U. per cubic foot. In the carbonization of 60,000 tons of coal 240,000,000 cubic feet of gas would be produced as a by-product.

This gas is valuable as a source of power for brick-burning, domestic heating and for all purposes requiring heat or fuel. The candle-power is below the standard for lighting, but it could be used to generate electricity for lighting purposes.

In brick burning gas fuel is very desirable, as it permits an even and uniform burn throughout the kiln, and requires less labor for firing and attendance than coal firing.

Market for Gas

The Estevan electric light plant is too small for present requirements, and the city would be pleased to take gas to increase its capacity. This plant would require gas of at least the equivalent of 4,000 tons of lignite at $2.10 (pre-war price). There is no city gas plant in operation, and the city still holds the franchise. There is, therefore, a potential market at Estevan for some 10,000,000 cubic feet per annum for heating and cooking purposes, provided the city undertook the distribution.

After meeting the above requirements there would still be a surplus of about 70,000,000 cubic feet per year. There is no demand for this surplus at present, but it would be available for extension of the Estevan power plant and for encouraging the development of manufacturing enterprises.

Estimated Cost of Carbonizing and Briquetting

According to estimates prepared by R. A. Ross, chairman of the Lignite Committee, Honorary Advisory Council for Scientific Research, the cost for carbonizing and briquetting, at a plant producing 30,000 tons per annum, would be as follows:

Total cost of plant, etc	$366,534
Fixed charges—Interest, 6 per cent; depreciation, 10 per cent.; repairs, 4 per cent.	73,307
Fixed charges per ton of output	2.45
Total operating expenses	4.55
Total cost of carbon briquettes, per ton	$7.00

This estimate is based on a cost of $1 per ton for coal, but if a market for gas be not considered, and, assuming that the plant were constructed at Bienfait, the requisite amount of coal is estimated to cost $1.12½ per ton. As two tons of coal are required in the production of one ton of briquettes, this would increase the cost of briquettes 25c per ton over Mr. Ross' estimate, or a total cost for producing one ton of carbonized briquettes of $7.25.

The following table shows the estimated cost of carbon briquettes compared with the price of United States anthracite coal in certain cities in Manitoba and Saskatchewan:

Comparative Cost of United States Anthracite Coal and Carbon Briquettes in Manitoba and Saskatchewan

City	Price of U.S. anthracite per ton f.o.b.	Carbon briquette		Difference in favor of carbon briquettes
		Freight and Switching	Estimated price, f.o.b. cars	
Winnipeg	$ 9.50 to $10.00	$1.90	$10.15	
Portage la Prairie .	10.00 " 10.50	1.80	10.05	. 0 to .45
Carberry	10.65 " 11.15	1.60	9.85	.80 " 1.30
Brandon	10.60 " 10.85	1.50	9.75	.85 " 1.10
Virden	10.80 " 12.15	1.60	9.85	.95 " 2.30
Moosomin	11.00 " 12.25	1.80	10.05	.95 " 2.20
Wolseley	11.50 " 11.75	1.80	10.05	1.45 " 1.70
Regina	11.60 " 12.25	1.60	9.85	1.75 " 2.40
Moose Jaw	11.45 " 12.35	1.50	9.75	1.70 " 2.50

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*Including profit of $1 per ton.

Analyses show that the heating values of carbonized lignite briquettes and anthracite coal are practically equal, and, in practice, the briquettes and anthracite will stand comparison very closely on the basis of cost. The briquettes should, however, be made from lignite low in ash, that the calorific value may be kept as high as possible.

No difficulty should be experienced in getting coal dealers to handle carbon briquettes, provided there is a fair margin of profit.

The general report of the Minister of Public Works and Labor of the Province of Quebec for the year ending June 30, 1917, has just been issued. It contains the special reports of the heads of the various branches respecting the construction and maintenance of government buildings, railways, the inspection of industrial establishments and public buildings, the carrying out of the Trades Disputes Act, the building of iron bridges, the working of the provincial employment bureaux, hotel inspection, the accounts of the department, etc.

The Department of the Interior, Ottawa, has issued a report on irrigation surveys and inspections for the year ending March 31, 1917, comprising reports by E. F. Drake, superintendent of irrigation, and F. H. Peters, commissioner of irrigation and chief engineer.

Building Permits Show Increase

BUILDING work, as indicated by the value of building permits issued in 35 cities, showed an increase during January as compared with the previous month, the total value of permits rising from $874,559 in December to $1,562,637 in January, an increase of $688,078, or 78.7 per cent. As compared with the corresponding month of 1917, there was an increase of 11.5 per cent., the value for January, 1917, being $1,401,932. In this comparison, large increases were shown in Alberta, British Columbia and Nova Scotia. A small gain was also reported in Ontario.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-Five Cities

	January, 1918	January, 1917	January, 1918, compared with January, 1917	
			Increase (*)	Decrease(†)
Nova Scotia	**$71,280**	**$22,855**	* **$48,425**	* **211.88**
Halifax	62,470	20,055	* 42,415	* 67.89
Sydney	8,810	2,800	* 6,010	* 214.64
New Brunswick	....	**3,500**	† **3,500**	....
Moncton	....	3,500	† 3,500	....
Quebec	**167,482**	**613,448**	† **445,966**	† **72.70**
Maisonneuve	....	120,000	† 120,000	....
Montreal	116,110	249,895	† 133,785	† 53.54
Quebec	30,572	117,938	† 87,366	† 74.08
Sherbrooke	....	9,000	† 9,000	....
Three Rivers	19,300	112,000	† 92,700	† 82.77
Westmount	1,500	4,615	† 3,115	† 67.49
Ontario	**611,120**	**590,414**	* **20,706**	* **3.51**
Brantford	5,245	2,000	* 3,245	* 162.25
Fort William	80,000	50	* 79,950	*159,900.00
Guelph	....	1,000	† 1,000	....
Hamilton	50,000	51,825	† 1,825	† 3.52
Kingston	5,195	4,340	* 855	* 19.70
Kitchener	3,600	275	* 3,325	* 1,209.09
London	17,150	14,435	* 2,715	* 18.81
Ottawa	8,875	54,650	† 45,775	† 83.76
Peterborough	3,300	11,625	† 8,325	† 71.61
Port Arthur	16,895	21,276	† 4,381	† 20.59
Stratford	2,945	1,780	* 1,165	* 65.45
St. Catharines	3,035	4,428	† 1,393	† 31.46
St. Thomas	....	5,200	† 5,200	....
Toronto	409,965	394,880	* 15,085	* 3.82
Windsor	4,915	22,650	† 17,735	† 78.30
Manitoba	**41,100**	**79,176**	† **38,075**	† **48.09**
Brandon	....	10,725	† 10,725	....
Winnipeg	41,100	68,450	† 27,350	† 39.96
Saskatchewan	**5,800**	**54,575**	† **48,775**	† **89.37**
Moose Jaw	....	51,000	† 51,000	....
Regina	700	2,200	† 1,500	† 68.18
Saskatoon	5,100	1,375	* 3,725	* 270.91
Alberta	**507,700**	**3,800**	* **503,900**	* **13,260.53**
Calgary	505,300	3,300	* 502,000	* 15,212.12
Edmonton	2,400	500	* 1,900	* 380.00
British Columbia	**158,155**	**34,165**	* **123,990**	* **382.62**
New Westminster ..	1,650	1,300	* 350	* 26.92
Vancouver	53,125	29,045	* 24,080	* 82.91
Victoria	103,380	3,820	* 99,560	* 2,606.28
Total—35 cities ..	**1,562,637**	**1,401,932**	* **160,705**	* **11.48**

The Council of the Canadian Society of Civil Engineers has appointed the following as members of the Council: Mr. J. G. Sullivan, chief engineer Western lines, C.P.R., Winnipeg; Mr. H. W. McLeod, assistant engineer, C.P.R., Winnipeg; Mr. F. H. Peters, commissioner of irrigation and chief engineer, Department of Interior, Calgary; and Mr. L. B. Elliott, district engineer, Dominion Public Works Department, Edmonton.

In order to better serve the Ontario trade, the Canada Car and Foundry Company, Ltd., have opened an office at No. 301 Royal Bank of Canada Building, Toronto, under the direction of Mr. G. F. Richmond, Jr.

The work of the Topographical Surveys Branch of the Department of the Interior amounts to something in the neighborhood of 200,000 miles a year.

Unsafe Scaffold Planks Court Accident

MANY serious and many fatal accidents are caused by falls due to scaffolds breaking. The construction of scaffolds of either unsafe or improper material is only courting accident, and care should be taken to see that the work of constructing scaffolds is carefully and thoroughly carried out and nothing but selected, first-class materials are used in building them, so that they will safely stand the load which they are intended to bear. The bulletin of the Pennsylvania Department of Labor and Industry quotes the following case of improper scaffold construction which resulted in a fatal accident:

Recently an employee of an electric manufacturing company was making some repairs to a fan support under a ceiling. He was using the traveling crane as a base for his scaffolding, and he had placed several planks across between girders, which were about six feet apart.

The planks he selected were 6 in. by 2 in., and, carelessly or thoughtlessly, he used one with a knot which extended half across the plank. When he stepped on the plank it broke under his weight, and he fell to the floor, sustaining injuries from which he died.

Although the employee was an experienced rigger who had been doing this class of work for years, and was, moreover, in charge of the work at the time of the accident, he failed to select first-class material, even though there was a large supply of lumber nearby to choose from.

Program for Toronto A. I. E. E.

The Toronto section o fthe American Institute of Electrical Engineers has arranged the following program for the month of March:

Friday, March 1: A paper by Mr. R. P. Jackson, of the research division, Westinghouse Electric and Manufacturing Company, Pittsburg, on the subject, "Commercial and Industrial Research."

Friday, March 8, is the date of the institute meeting at Cleveland, in which the Toronto section is participating as a host. An interesting program of papers relating to underground distribution and the use of electric drive in steel mills has been arranged; also a joint meeting with the Association of Iron and Steel Electrical Engineers and an informal dinner.

On Friday, March 15, Mr. J. J. Frank will come up from the General Electric Company, Pittsfield, Mass., to give a paper on "Recent Developments in Transformer Practice."

The German Standard of Warfare

THIS remarkable illustration is the reproduction of an actual photograph taken "Somewhere in France" by an aviator, who has since been killed in action. The Germans had surrendered and were advancing under the white flag, when suddenly the front line threw themselves on the ground (note the white flag) and the entire company opened fire on the British. The original photo was very small in size and the enlargement has resulted in some blurring of the features, but nevertheless, a close study, with a magnifying glass, if one is available, reveals the brutal gloating with which the Huns are contemplating the success of their treachery. The photographer was just on the point of "snapping" the surrender, which accounts for his securing a picture that, under other conditions, would have been impossible. It is a vivid portrayal of the type of enemy our boys are up against and the unflinching courage with which they are facing death.

A Travelling Anti-Waste Exhibit

In a large manufacturing plant where thousands are employed it is surprising to learn of the food products and manufacturing material wasted each day. To give the employees of the Westinghouse Electric and Manufacturing Company some idea of the waste the management devised the novel scheme of fitting up a storage battery truck as a travelling exhibit, upon it a collection of foods wasted, including bread, butter, meat, cakes, crackers, pickles, cheese, fruits, etc., as well as a quantity of manufacturing materials, such as copper, zinc, lead, mica, rubber, felt, gum, and similar materials, much of which could be used to advantage. It is estimated that the foodstuffs wasted per day amounts to between $35 and $50, the cost of which, of course, comes out of the employees' pockets, the waste of material amounting to hundreds of dollars per day, which would be a loss to the company if it were not that a force of men are continually assorting the seemingly scrap material and turning it back for use or so that the highest price may be obtained for scrap produce, all due largely to the thoughtlessness and carelessness of the employees. Above the material was constructed a sign reading, in large letters, "Wasted," and underneath the words, "Food brought from your homes," and on the other side, "Materials belonging to the company." This truck was driven up and down the shop aisles so that the employees could look upon it and form in their minds some idea of the waste. Such an object lesson is valuable at this time, when everyone should take all precautions necessary to effect as little waste as possible.

Striking exhibits of waste products.

Personals

Colonel J. S. Dennis, chief commissioner of the colonization and development department of the C.P.R., and immediate past president of the Canadian Society of Civil Engineers, has been elected president of the Canadian Forestry Association.

Obituary

Cadet William Clarence Tanner of the firm of Tanner & Tanner, architects, Guelph, Ont, passed away recently at Camp Borden, as a result of an attack of scarlet fever. The deceased joined the Royal Flying Corps last December and a short time ago went into active training at Camp Borden, where he contracted the fever. He was born in Guelph 26 years ago, and took up architectural work in his father's office in that city.

Mainly Constructional

East and West—From Coast to Coast

Hamilton items passed on the estimates of the Ontario Legislature include $92,027 for additions and improvements to the hospital for the insane. Of this amount $40,000 is appropriated for a new building and $10,000 for a boiler-house.

Plans for the expropriation of the land required for the new departmental office building for the government at Ottawa have been filed. This structure, which will contain 700 rooms, will be in the form of a square, 200 x 100 ft., with a courtyard in the centre.

Rumors are current to the effect that work on the new store building which the T. Eaton Company propose to erect at the corner of College and Yonge Streets may commence this spring. A permit for one portion of the structure, to cost $3,000,000. was taken out last year, but no further action was taken.

The Canadian Steel Corporation has received the approval of Dr. J. W. S. McCullough, chief provincial medical health officer, and has decided to go ahead this spring with the construction of a waterworks plant at Ojibway, the site of their big steel plant and industrial town. The plant will have a daily pumping capacity of 7,000,000 gallons.

It has been decided to rush work on the portions of the new parliament building at Ottawa which contain offices. This is with a view to meeting the pressing and growing need for office buildings for the government departments. The two wings which will be rushed to completion will contain 82 large offices. It is expected to have these ready for occupation by November.

The Militia Department has made application to the City Architect's Department for a permit to increase the height of the National Cash Register factory on Christie Street, Toronto, which they recently acquired for the purpose of using as a hospital. Part of the building is now one storey and part two storeys, and it is proposed to raise it to four storeys, at an expenditure of about $140.000.

One of the important subjects to come up for discussion at the present session of the British Columbia Legislature, at Victoria, is the encouragement of the iron and steel industries within the province. It is announced that the government is securing the services of an expert to advise on the electro-thermic treatment of iron ores, together with other measures which will serve to encourage the development of the iron ore deposits so extensive in British Columbia.

At a recent meeting, members of the operating and designing departments of the Dominion Iron and Steel Company, at Sydney, N.S., decided to organize an engineering society within the company's staff, for the purpose of encouraging the exchange of information on technical and practical matters and to promote unity between those of the steel work's staff who would be included in its membership. The organization will also be partly of a social character.

Building permits issued in Halifax, N.S., during the month of January were mainly for repairs to buildings damaged by the explosion, and the total value of the work undertaken was $62,476, as against $20,880 for the same month of 1916. One of the largest contracts is that in connection with St. Patrick's Church, now being carried out by S. M. Brookfield. Ltd. The roof was shifted by the shock of the explosion having apparently been lifted up and fallen back out of place. The readjustment demands the removal of the whole roof and then its replacement in the exact original position.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Elma Township, Ont.
Township Council contemplate the construction of a 14 in. tile drain costing $3,000. Engineer, John Rogers, Mitchell.

Tenders are being received by the engineer, John Roger, Mitchell, until March 9 for drainage work, including three culverts costing $7,000, for the Township Council. Clerk, Geo. Lochead, Atwood.

Fredericton, N.B.
City Council contemplate the construction of a pavement on Main Street from Adelaide to Cedar, at a cost of $34,000. Engineer, Geo. McKnight.

City Council contemplate the installation of waterworks pumps. Engineer, Geo. McKnight.

Hull, Que.
City Council contemplate the construction of sewers, sidewalks, etc., costing $8,000. Engineer, J. A. Laforest.

Longeuil, Que.
Town Council contemplate the construction of roads from St. Lambert to Levis. Clerk, J. R. Bournet.

St. Johns, Que.
Town Council contemplates the construction of $35,000 sewer system and catch basin. Tenders will be called in the spring. Clerk, J. A. Raymond.

Ste. Tite, Que.
Town Council will call tenders about May 1 for laying gravel about three miles within the city. Clerk, J. J. Cloutier, N. P.

Toronto, Ont.
The Board of Control contemplate the purchase of water meters costing $50,000. Works Commissioner, R. C. Harris.

Verdun, Que.
Tenders will be called later for repairs and reinforcements to waterworks and electric plants at a cost of $50,000 for the Town Council. Clerk, Geo. A. Ward.

CONTRACTS AWARDED

Three Rivers, Que.
Nobert Dugre & Arsenault, Hochelaga Bank Bldg., have the contract for reservoir and Oliver & Co., 296 St. James Street, Montreal, the contract for five-ton travelling crane for pumping station in connection with the construction of a pumping station and reservoir costing $12,000, for the City Council.

Railroads, Bridges and Wharves

Eramora Township, Ont.
Township Council contemplate the erection of a few cement bridges this summer. Clerk, J. J. Aldons, Rockwood.

Three Rivers, Que.
The Three Rivers Traction Company, St. Maurice Street, contemplate extension to their electric railway at a cost of $28,000. Engineer, J. H. McNeil, 25 Plaisante Street.

The Three Rivers Traction Company, St. Maurice Street, will erect a $3,000 1½ storey frame railway station at the corner of Gervais and St. Philippe. Architect, J. H. McNeil, 25 Plaisante Street.

Verdun, Que.
Town Council contemplate erection of protection to dyke works at a cost of $100,000. Engineer, A. S. Clarson.

CONTRACTS AWARDED

Port Arthur, Ont.
D. J. Cantwell, Park Street, has the painting and decorating contracts in connection with repairs costing $15,000, to station for the Canadian Northern Railway, head office, Toronto.

Public Buildings, Churches and Schools

Bow Island, Alta.
Bow Island School District contemplate the erection of a $16,000 school this spring. Secretary, W. A. Bateman, Bow Island.

Cap de la Madeleine, Que.
The erection of a $125,000 stone and concrete church is contemplate. Rector, Rev. Father Valiquet.

The School Board have secured a site on which they will erect a $40,000 brick school. Chairman, Mederic Boisvert.

Dartmouth, N.S.
Town Council contemplate erection of town hall and jail. Clerk, A. Elliot.

The School Board have decided to call for competitive plans for four-roomed frame school to be erected on Wyse Road. Secretary-treasurer, Alfred Elliott, Town Hall.

Farnham, Que.
Tenders received by the secretary, R. C. Desrochers, Ottawa, until 4 p.m., March 14, for alterations and addition to public building for the Department of Public Works, Dominion Government.

Foremost, Alta.
Plans are under consideration for the erection of a consolidated school for the Foreomost Consolidated School District. Chairman of Board, B. Carrington.

Grand Prairie, Alta.
The Department of Public Works, Dominion Government, have secured a site on which they will erect a $5,000 Land Titles office building. Secretary, R. C. Desrochers, Ottawa.

Hamilton, Ont.
Plans are being prepared for a $25,000 hall to be erected by the Knights of Pythias. Architect, F. W. Warren, Bank of Hamilton Bldg.

F. W. Warren, Bank of Hamilton Bldg., is preparing plans and tenders will be called about March 7 for alterations costing $10,000, to church for the Jewish Synagogue, 141 Hughson St. S.

Highland Creek, Ont.
James, Louden & Hertzberg, Excelsior Life Bldg., Toronto, are preparing plans for $11,000 brick school for School Section No. 7, Scarboro Township. Secretary, John Brooks, Agincourt.

Kingston, Ont.
The estimates of the Hospital for the Insane, Department of Public Works, Provincial Government, Toronto, include $2,500 for reconstruction of bathrooms and closets, $2,000 for reconstruction of electric light system, $10,000 for remodelling and addition to present building and $1,500 for fire alarm and fire protection system.

Mannville, Alta.
The erection of a hospital is contemplated. Address, Reeve, D. B. MacLean.

Namao, Alta.
Work will start shortly on the erection of a $7,200 one-storey brick veneer school for the Sturgeon School District No. 24. Architect, E. W. Morehouse, 304 Williamson Block, Edmonton.

Ottawa, Ont.
The Orange Order contemplate the erection of a hall.

Perth, Ont.
The Separate School Board contemplate the erection of a school at the corner of Gore and Craig Streets.

Petrolea, Ont.
Tenders are being received by the secretary, Wm. Pratt, until March 14, for the erection of a $10,000 addition to hospital for the Charlotte Eleanor Englehart Hospital. Architect, John W. Moore, 45 Richmond Street, London.

Quebec, Que.
The Parish of St. Louis de France contemplate the erection of a church. Curate, Rev. Pere Dagueneau.

Regina, Sask.
The Exhibition Board, City Council, contemplate the erection of fair buildings costing $140,000. Manager, D. T. Elderkin, McCallum Hill Bldg.

St. Damase, Que.
Tenders will be received by the architect, P. Levesque, 115 St. John Street, Quebec, until March 1, for the erection of a stone and steel church for the Parish Congregation.

Sherbrooke, Que.
City Council contemplate the erection of a $250,000 technical school. Secretary-treasurer, E. C. Gatien.

City Council contemplate the enlarging of the market and erection of a new building at a cost of $6,000. Clerk, E. C.

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Ontario Good Roads Week

THE week of February 25-29 might well be called "Good Roads Week" in Ontario, as during the first four days there was held a most successful conference of road superintendents at the Highways Department of the local Government, now an annual event, and somewhat unfortunately overlapping in part the Ontario Good Roads Association, which held its annual convention in the York County Buildings on February 27, 28, 29. A full report of the Highways Conference is given in the present issue, but lack of space makes it necessary to hold over till next week any extended reference to the Ontario Good Roads Association Convention. This latter report will be published in our issue of March 13.

The good roads movement in Ontario is worthy of all support not only on account of what, theoretically, it can do for the betterment of rural conditions, but also for what, in actual fact, it has already done. That so much has been accomplished is due to the splendid organization of our Government Highways Department, the efficiency of its officers and the hearty co-operation of other provincial and municipal organizations, chief among which, of course, is the Ontario Good Roads Association. This latter association, too, has been particularly happy in the choice of officers, and is fortunate indeed in having as a permanent officer such an all-round man as George S. Henry, who, as a university graduate, a practical farmer and an experienced parliamentarian all rolled into one, is an outstanding figure in the discussion of such matters as "good roads" where a wide vision and an appreciation of the viewpoint of all classes is so essential.

Whatever may be said of "business as usual" in general, during the war, there are few, we believe, who are not in favor of a fairly liberal policy in the way of road building and maintenance. Good roads have a direct bearing on food production and on food cost. In case of further trouble with our main transportation arteries they may have just as direct a bearing on the manufacture and supply of war material. Our government is thus well advised in setting aside as much money as is reasonably available for this work and may be assured that such action meets the popular approval. In addition to what it is possible to do at the moment it is to be hoped, also, that plans are being laid for effective and immediate, and much more extensive, operations when the war is over.

In connection with this year's Conference of the Highways Department, which is designed primarily and specially for the benefit of the various county road superintendents of the province, now thirty-seven in number, it is noted that the program includes a number of papers by the superintendents themselves. At former conferences this work has been chiefly delegated to members of the Highways Department, and we cannot but feel it is a move in the right direction that the proceedings should be given this leaven of practical experience which the men on the firing line are best capable of bringing in. This year's program is well balanced and will undoubtedly result in greatly furthering the interests of the good roads movement throughout the province.

"Dark Often Found Me in My Garden at Work Last Summer"

A BILL has been introduced in the Ontario Legislature by Major Hartt, requiring that our clocks be set ahead one hour between the dates of April 1 and November 1. Major Hartt has had the advantage of experience in daylight saving in France, and evidently is convinced of its value. If successful in France why not in Ontario?

In a recent issue of the Contract Record we took occasion to direct the attention of our readers to this matter and its bearing on food production. If back-lot and vacant-lot gardening is worth encouraging at all, if the amount of food that can be produced in this way is really a factor in relieving the food shortage, and we believe it is, then surely an extra hour every evening for the gardeners is an important and well-deserved concession. Many garden enthusiasts are men who work long hours and get, at most, perhaps an hour to an hour and a-half each evening. Thus the extra hour would practically double the time, and incidentally the production, of these workers. Not only would it have its influence in this way, but the extra long evenings would have a decided tendency to induce those who have been indifferent in the past, those who have felt they had not the time at their disposal, to become producers.

It will thus be seen, too, that the extra hour in the evening will benefit that class of our citizenship which is most in need of assistance—the man with the long-hour day; that is, generally speaking, the man with the lowest pay. Such a move will be "mass" rather than "class" legislation, and, as such, should easily appeal to our law makers. It will benefit most the man who works by clock, not the man who can "knock off" in the middle of the afternoon if he feels so disposed.

It has been hinted that the Dominion Government is waiting for pressure from the electors. That is unfortunate, though entirely natural. Would it not be a good idea if our readers would sit down and write immediately to Ottawa some such letter as one just received by us from a "producer" in one of the eastern provinces. This correspondent commends us for our previous editorial, tells of his son being at the front and how he is trying to further assist the government in his small way by growing his own vegetables, etc., etc. His letter concludes;

"I am running my business with the assistance of my youngest son and daughter. I have a small place where we grow all our vegetables, potatoes and apples, and can keep two cows. We find it a great help these times, and as **dark often found me in my garden at work last summer,** I am glad to see your journal goes in for 'daylight-saving.'"

Manitoba Good Roads Convention

On February 19th in Manitoba Hall, Winnipeg, the Manitoba Good Roads Association held a banquet in connection with their annual meeting. Great enthusiasm was displayed at this meeting in the cause of building a permanent system of leading roads throughout the province and the attendance was the largest in the history of the organization. The election of officers for 1918 resulted in the return of the former executive—President, S. R. Henderson; vice-president, R. D. Waugh; secretary-treasurer, Geo. F. Bentley.

Following the banquet, Mr. Henderson submitted the presidential report, in which he stated that the expenditure for the construction of roads and bridges in Manitoba during the past year amounted to $466,946.26. Manitoba had now 1,922 miles of road under the Good Roads Act, and in addition, during the year, 1,379 miles of road had been systematically maintained by the use of the split-log drag. The expenditure on bridges within the province during the same period had totalled $169,111.57. Mr. Henderson also informed the members that, following the suggestion of Premier Morris, the provincial government had presented two handsome trophies—one for the best dirt road and one for the best gravel road—to be competed for this year for the first time.

Mr. Waugh, the vice-president, also spoke, tracing the history of the good roads movement in the province, from its inception in February, 1909, to its present wide development. He stated that 75 per cent. of the automobiles in Manitoba were now owned by farmers, and that this fact has given a great stimulus to road improvement.

Among the other speakers were, Hon. Geo. Grierson, Minister of Public Works, Mayor Davidson, of Winnipeg, Messrs. T. R. Deacon and A. C. Emmett.

The association carried a motion that the provincial government be asked to engage the services of a road expert for the whole year, instead of for only two months, as at present. The problem of keeping roads open for traffic during the winter was also discussed. The use of rollers for this purpose was mentioned, but some of the members declared that this method had not proved successful in Manitoba. Another plan was the employment of the road drag, which some of those present said had been satisfactorily tried in certain districts.

To Study After-the-War Problems

A movement has been started in Montreal having for its object a Dominion-wide organization for studying problems which will develop as the result of the war. The idea is to form in the central city of each province a standing committee of plans and propaganda, with later a Dominion council, with its standing committee. Sir Robert Borden has expressed approval of the movement, which will co-operate with the government in any measures to solve the problems, supply information on many subjects, and co-ordinate the efforts now being made, and which may be attempted, in order that the energies of various societies and individuals may be concentrated.

Thousands of forms have been sent to various parts of Canada in an endeavor to get the organization under way as quickly as possible. The problems named in the circulars as those most demanding the careful thought of all are in connection with business readjustments, the prevention of unemployment, the returned soldier, general social well-being, industrial and economic questions, capital and labor, immigration and the development of our natural, agricultural and other resources.

Among those who have joined the organizing committee in Montreal are, Messrs. Francis Hankin, honorary secretary; T. McC. Hutchinson, of Drummond, McCall & Co.; C. Gordon Mitchell, architect; Captain Skinner, of the Canada Cement Company.

The "Uncertain" Ways of Councils

An unusual incident occurred at the last meeting of the city of Verdun Council. Ald. Allard asked for the immediate resignation of Mr. A. S. Clarson, the city engineer, on the curious ground that there is practically no work for that official—this, too, in a locality which recently obtained powers for carrying out extensive works. The opinion of Ald. Allard did not meet with approval, and the council, with a view to privately discussing the question, went into committee. Mr. Clarson then gave the committee his views, and on the committee again meeting as council, the motion was withdrawn.

A sub-committee of the war committee of the Dominion cabinet, to be known as the "Canada Registration Board," has been constituted by an order-in-council recently passed.

Defining the Status of the Engineer

Ottawa Branch C. S. C. E. Endorses Action of Calgary Branch — Advisability of Seeking Dominion Legislation

AT a special meeting of the Ottawa branch of the Canadian Society of Civil Engineers, held in Carnegie Library, Thursday evening, February 21, Mr. F. H. Peters, Mem. C.S.C.E., Commissioner of Irrigation of the Department of the Interior, Calgary, addressed the members.

Some weeks ago the Calgary branch of the C.S.C.E. at their annual meeting discussed at considerable length the desirability of asking Dominion legislation to define the status of the engineer, and a resolution to this effect was adopted and forwarded to Council and to the various branches of the Society for consideration, and, if they deemed advisable, further action. The attitude of the Calgary branch followed a report prepared by Mr. Peters and approved by the Executive Committee of the Calgary branch. This report was also forwarded along with the resolution. That the situation may be thoroughly understood by our readers we are reproducing herewith both Mr. Peters' report and the resolution of the Calgary branch.

Resolution

That it is desirable at this time for the membership of the Society to discuss the advisability of seeking Dominion legislation which shall define the status of the engineer to the end that the profession and the public may be adequately protected against the practice of the profession by unqualified persons.

That the secretary of the Society be requested to take the necessary steps to procure discussion on this matter within all the branches of the Society; to obtain a definite expression of opinion from all the branches; and in due course to report to Council and to all the branches, the concensus of opinion expressed.

That with a view to facilitating discussion within the various branches, a report be attached to this resolution, indicating the evolution of this matter within the Calgary branch and suggesting the lines along which suitable legislation may be framed.

Mr. Peters' Report

At the executive meeting of the Calgary branch on October 1st, a motion was put and carried to the effect that at this time the members of the Canadian Society of Civil Engineers should discuss the desirability of making the Society forward not only the advancement of scientific learning, but also the advancement of the material interests of the members.

Arising out of the great responsibilities that Canada has had to face, owing to the great war, there has undoubtedly been a Dominion-wide feeling that we must "set our house in order." This feeling, communicating itself to the body of engineers in Canada, seems to have crystalized the feeling which has for a long time been in evidence, that all was not well with them, and the result has been a feeling of unrest and dissatisfaction. Before long the general feeling took a definite form in the realization that the engineer was not accorded the standing or recognition in the community which, by virtue of his profession, he deserved.

After this the question was naturally asked, "to whom must we look to rectify this condition?" and the "Civil" engineer naturally turned to his own national organization, the Canadian Society.

Looking at the matter in a very broad way, this indicates the reason why the resolution referred to above was put before the executive of the Calgary branch, who at that time went on record to the effect that in their opinion the general membership demanded more of the society than the advancement of scientific learning—they demanded also the advancement of their own material interests.

From this time on the discussion of the matter at Calgary was very active, and it is difficult to put on paper all the "ways and means" that were discussed. Naturally the discussion all centered around the question "how is the desired end to be gained?"

Mr. F. S. Keith, the Secretary of the Society, in visiting the Calgary branch in August last, suggested that the end in view might be gained by a properly conducted publicity campaign. It is apparent that any movement made to better the standing of the profession must depend very largely for success upon publicity. But could a publicity campaign alone possibly establish the profession on the solid footing that is desired? The local census of opinion answered this question in the negative and regarded publicity only as one of the strong means which must be employed to achieve the desired result.

The question was discussed from many angles and many different positions were taken. But all were found to be assailable except the final one adopted, that the engineering profession must have a legal standing. Space will not permit of even indicating the many arguments that were advanced pro and con. But the simplest one is perhaps the best; to wit, if the profession is to have a proper standing it must be one that is defined by the law of the land.

And to dispose of one bugbear at this point. Some local members raised the cry—"this means the close corporation," and some went further and said, "this means trade unionism," but more considered thought disposed of these attitudes. It was pointed out that the two great professions of medicine and law have a standing that is defined by the law and they are not accused of forming a close corporation that is detrimental to the best interests of themselves or the people at large.. And trade unions are not based on any legal standing such as is sought for the engineering profession—their strength is based upon an entirely different principle. The last point has been mentioned because the feeling indicated has existed with many and perhaps still does exist with some engineers. Why engineers should foster a pride in their profession which is outraged by seeking protection for it, is a question that is difficult to answer with sound practical argument.

The resolution, to which this report is attached, was carried by the Calgary branch in culmination of the considerations which are noted below in proper sequence.

1. The general feeling of the branch was in favor

of action on the matter under discussion being taken.

2. That the proper action was for the Society to gain Dominion legislation.

3. That if the whole membership of the Society was in favor of obtaining the legislation there should be no insuperable obstacles.

4. That the first step to be taken was to start such action as would as quickly as possible obtain a definite expression of opinion from the Society as a whole.

5. That to accomplish this end the best way was for the Branch to suggest in general terms the kind of legislation that should be sought.

Suggested Legislation

The suggestions which follow as to the proposed legislation were made in as general terms as possible, as indeed they must be in order to allow of a general expression of opinion from the whole membership and to avoid a premature discussion of details which would be out of place at this time.

To a very large extent the suggested legislation would follow out the spirit and intent of the Manitoba and Quebec Acts concerning civil engineers. That is to say, the status of an engineer would be defined by law and sufficient and easily enforced penalties would be provided to penalize persons practising the profession who did not have the proper legal status.

The legislation sought, however, would be Dominion, not provincial. The desirability of this change does not appear to require any lengthy argument. If an engineer is qualified to practise in Ontario he certainly should be qualified to practise in Alberta, and vice versa. The incongruities of the provincial laws covering the medical and legal professions are well known, whereby, for example, a most eminent physician from Ontario is debarred from practising in Alberta.

Again, following the lines of the provincial acts, quoted above, the gaining and maintaining of the necessary legal status to allow of practise would necessitate the gaining and maintaining of registration as a member of the Engineering Institute of Canada. And in this connection there is suggested the one radical and new idea, which is, that registration with the Institute could be gained only on the issuance of a certificate granted by a board of engineers, which would be controlled by the science faculties of all the recognized universities in Canada and not by the Council of the Institute. And similarly, the grading of the registered members would be controlled by the Board of Engineers.

Protection for the Public and the Profession

This radical idea is suggested with a view first, of stifling all criticism on the ground that the engineers seek to form a close corporation. We would be taking this stand:—We ask for legislation which, by defining our status, will protect both the public and our profession; an organization of which every engineer must be a member is necessary in order to foster the advancement of the science of our profession and to maintain discipline in the profession, but so that under no circumstances can we become a close corporation which might overlook the best interests of the public, we invite a measure of outside control.

And secondly, it seems proper that the control of those who may practice the profession should in some degree be placed in the hands of those institutions of learning which are maintained by the government or by the public to teach the fundamentals of the science of the profession. The idea suggested would seem to give control by a most desirable co-operation between those most highly trained in theory and those most highly trained in practice.

The Institute would then be enormously strengthened by having registered in its membership every engineer in Canada. The Institute would have its constitution and carry on its work in much the same way as at present. It would function mainly in fostering the advancement of scientific learning and in maintaining discipline in the membership. The Institute would be particularly active in prosecuting every person who practised without having the proper status. The Institute, through the properly constituted channels would see that no person maintained his registration who was guilty of any mal-practice, unprofessional conduct, etc.

At Present Only for Civil Engineers

It is to be particularly noted that when the resolution, to which this report is attached, was explained and put before the Calgary branch, it was meant to apply specifically to civil engineers. It was pointed out at the general meeting that for many reasons the sought for legislation should cover the whole field of engineering and not only civil engineering. In reply it was explained that while the general idea put forth was agreed to, that at present the Canadian Society could only claim to represent, and speak for the civil engineers and that if we were to seek in the first place legislation covering all branches of the profession that a great deal of organization would first be necessary to get all the branches of the profession pulling together, and that for this reason it was thought better for the organization as it existed to seek legislation only for the civil engineers, and assume that if this was gained that the other branches of the profession would naturally follow suit and would find their coming in very much facilitated by the pioneer work of the civil engineers. The feeling of the meeting was, however, finally that at this time the whole question should be left open so that if the other branches of the profession wanted to come in at this time, they could, On this understanding the original resolution was changed so as to leave out the word "civil" and use the broad term "engineers." Similarly, in writing this report it has been the endeavor to deal with the broader aspect.

And finally to those who would question and say "if the suggested legislation is gained, how will this advance our material interests?" The reply is made that our material interests can only be advanced by first gaining the status defined by law, which can alone put our organization on a solid footing, and then look to the activity from within the body of the engineers themselves to gain the needed advancement of our material interests.

The Ottawa Address

Mr. Peters' address before the Ottawa branch consisted in a general way of a review of the discussion which took place between members of the Calgary branch previous to the adoption of this resolution. Following the address the matter was freely discussed by a number of the Ottawa members including Messrs. R. deB Corriveau, A. A. Dion, B. H. Fraser, Duncan MacPherson, John Murphy, James White, R. W. Smart, Black, Col. Anderson, A. F. McCallum, N. Cauchon, Uniacke, W. J. Dick and others. The opinions expressed were, in general, favorable to the Calgary proposal, though a number of the speakers doubted the possibility of obtaining Dominion legislation,

(Concluded on page 192)

Ontario Road Superintendents' Conference with Highways Department

Papers and Discussions During Four Days Solve the Multitudinous Problems of the Road-maker — Complete Proceedings Covered in Present and Next Following Issue

HON. F. G. Macdiarmid, Minister of Public Works, addressed the conference during the afternoon session of the first day. He regretted that no space was available at the Parliament Buildings and congratulated the conference on the occasion of their Fourth Conference. In part Mr. Macdiarmid said:

Your Conference meets annually to confer with the heads of the department and with each other upon the conditions that have developed. These conferences are of material benefit to the department, who are able to arrive at the cencensus of opinion of the men in the field. Only the counties of Durham and Peterboro are not in the present organization. The Act aims to be fair to both the province and county and has increased the scope of the counties. New conditions and new problems are constantly developing, necessitating new legislation. The present is not a very suitable time to make large expenditures because of the increased initial cost and the extreme labor shortage. Recently an application for a road was made by the County of Simcoe for the extension of the county road passing through Coldwater to Port Severn. An engineer was sent up to make a report on the cost. He called for tenders for gravel and the department received two, the lowest of which was $2.25 per yard for an average haul of two miles.

Modern road-making machinery is here to stay. The tractor and grader is a great labor and cost saver. Experience has shown us, and undoubtedly road superintendents have the same experience, that it is a mistake to buy the lighter type of either machine, but that it is much better to secure a machine of sufficient size to assure oneself of a sufficient reserve of strength and power. Road superintendents are selected by representative bodies throughout Ontario and the success or failure of the Act and the efforts of this department depend entirely upon the efforts of these men. The department will send out engineers and aid financially and sponsors your conference to aid you to obtain the very best results.

We have in Ontario some 8,000 miles of provincial roads, and the magnitude and ultimate results of our combined efforts are hard to estimate. A higher standard of work is being constantly demanded, but a large portion is going to be handled by earth roads.

Congestion has occurred and will become more and more aggravated in the United States and in Ontario. Good roads will materially relieve this congestion, since by good highways we extend the area from which a large centre gets its supplies.

Rural life is very closely associated with good roads. By helping the social life of rural districts and making life pleasant in these localities we will put a stop to the tendency rural population has of moving into urban districts.

We are anxious to obtain your viewpoint throughout Ontario and invite and encourage discussion so that methods can be debated. Here is the proper place and here are the proper men to discuss this matter. We have to frame laws to suit the province as a whole and advise townships to select a supervisor to look after road expenditure.

We do not wish to state that all councillors have proven failures as commissioners, but many a man has held public position who should never have undertaken the expenditure of public moneys. The department for a matter of three years are paying 25 per cent. of the salaries of township supervisors.

In conclusion, as long as you superintendents feel and know that these conferences are of benefit to you, you will find that the department will extend to you every aid that is possible.

Municipal Drainage and Highway Construction

In a paper on "Municipal Drainage as Related to Highway Construction," Mr. G. R. Marston dealt with this important subject more or less from the legal standpoint, explaining the workings of the two provincial laws, known as the Municipal Drainage Act and the Ditches and Water Courses Act, in their relation to the county road superintendent, and the procedure this official must follow in order to comply with their provisions. He pointed out the great importance of proper road drainage and the difficulty with which the superintendent is frequently faced in his efforts to dispose of the water. Here it was that the two above mentioned Acts were of value. The former dealt with large and expensive drainage projects, while the latter covered the smaller schemes and was of particular advantage to the road superintendent. Mr. Marston pointed out that the workings of the law had not been fully appreciated by municipal councils and to this was due the indiscriminate digging of large and deep ditches along road sides to accommodate adjacent land owners. As proprietors of the roads, municipalities had the same rights as the individual owning land, and no man had the right to ditch his land and damage the highway, nor had the municipality the right to drain the road to the detriment of an adjoining owner. In summarizing, Mr. Marston set forth the following advantages which the Ditches and Water Courses Act affords in the carrying out of highway drainage work: (1) The right to carry water across the lands of adjoining owners; (2) The right to make use of the main outlets provided under the Municipal Drainage Act; (3) The opportunity of having the work laid out by a competent engineer; (4) The right to appeal for a reconsideration of the award after a certain period in case the drain does not do the work expected of it; (5) The right of compelling other parties to keep their portion of the ditch in a proper state of repair.

Gravel Road Construction in Middlesex County

A paper was then presented by Mr. Chas. Talbot, C.E., county engineer and road superintendent, on

"Gravel Road Construction in Middlesex County." This paper outlined in a concise manner the history and methods of road construction in Middlesex County from the early days when highways afforded the only means of transport to lake ports, up to the present time. Interesting figures were given on construction cost, showing that over the entire period during which the county had control of the system of highways, the total expenditure on roads and bridges was $1,768,000, or $5,900 per mile, amounting to $174 per mile per year. The township gravel roads, totalling 1,350 miles, he estimated, had cost $4,640,000, averaging $3,450 per mile. These roads were built with but little attention to drainage and varied in width from 10 to 18 feet. Culverts were of concrete and bridges of concrete and steel. The roads were first gravelled by placing one-quarter cord of gravel on each ten feet, and this was added to as conditions demanded.

Mr. Talbot outlined the manner in which the Middlesex roads are managed by the county council. The system is divided into township divisions and the work in each is under the administration of a committee of the council consisting of the reeve and deputy reeves and the superintendent, all operations being under the direction and supervision of the superintendent. In order to provide systematic maintenance, the whole mileage of the roads is divided into sections averaging eight miles and each division placed under the direction of a competent man.

Mr. Talbot stated that an ordinary gravel road such as his county built and were maintaining would accommodate a mixed traffic not exceeding 350 to 400 vehicles. Where heavier traffic is to be expected, gravel, if employed, should be graded and constructed in a similar manner to a stone road, and bituminous binders must be used in its construction and maintenance.

Legal and Engineering Features of Eliminating Grade Crossings

In a paper on "Legal and Engineering Features of Eliminating Grade Crossings," Mr. E. R. Blackwell, C.E,. M.Can.Soc.C.E., gave some interesting information on this subject which is engaging the attention of highway and safety engineers to so great an extent at the present time. He pointed out that the great difficulty to be overcome was the cost, which in a great many cases was practically prohibitive. In Canada the matter was almost entirely in the hands of the Board of Railway Commissioners, who had the power to order such changes or alterations as they might deem advisable. In cities and towns the problem generally resolved itself into an entire revision of the railway grade line, which, in the majority of cases, was accomplished by the elevation of the tracks approximately 10 feet above the ground and the depression of the streets from 8 to 10 feet. It was found as a rule that the economic method of grade separation was to place the grade line of the railway on embankment, but topographical features had to be taken into consideration. As regards the minimum clearance of bridges over streets, the requirement in Canada was 14 feet, but there was some variation in states and cities across the line. In Ontario, the law provided that there should be a clearance of at least 7 feet between the top of the highest freight car and the lowest member under which the car was liable to pass.

Mr. Blackwell also pointed to the importance of properly laying out subway approaches and the difficulties in connection with drainage when the road is depressed to any great extent.

Discussion on Mr. Blackwell's Paper on Grade Crossings

Mr. Blackwell had shown on the screen a number of slides indicating dangerous crossings, one of which portrayed a level crossing. On one side of the road was a dense shrubbery of second growth, and on the other a building, so that the view on either side of the road was obstructed.

A number of subways were also shown, which while they eliminated the possibility of a train accident, made traffic on the highways very dangerous. For instance, a railroad running along a fill has a highway approaching it, say, at an angle of 30 degrees to the railroad tangent. It became necessary to build a subway under the railroad. The subway, being built by the railroad company, is put up as economically as is possible from their point of view, and it is natural that so long as they can construct something that relieves them of any responsibility in case of accident, they build without very much regard to the public welfare. Hence, the subway is built at right angles to their own right of way, instead of being built on the angle of 30 degrees, or parallel to the highway. The abrupt turns to swing through the subway are the cause of a large number of motor accidents.

Mr. McLean had some interesting remarks to make on this paper, which, in effect, were as follows:

The question of changing grades is constantly before our department, especially since the advent of the motor vehicle. Roads are a machine—at one time based on the effectiveness of a horse as a mode of conveyance, now based on the effectiveness of motor traffic. The railway board some time ago called a conference with a view to doing away with all level crossings. This was found impossible, owing to the extreme cost. Still, roads can be made much safer by removing trees and any other obstructions, and by diverting the highway. Concessions and side lines generally run at right angles to one another, but a railway may run diagonally across the country and cross a lot 200 or 300 yards from a corner. The highway could, in this case, be diverted to run parallel with the railroad, thus eliminating the necessity of crossing the track for a considerable portion of the traffic.

Mr. McLean said the problem of level crossings was not insurmountable, as it at first seemed. It was known that some highways carry 80 per cent. and more of the traffic. If these main highways are attended to, by placing conspicuous signs on the roadway 300 feet from the danger point and having trees and obstructions removed, the percentage of accidents will at once be lowered.

When the matter of who has the authority to cut trees was brought up during the discussion, Mr. James, of York County, said the proper mode of procedure was to give the property-owner ten days' notice, and, if he filed no objection, to remove the obstruction, acting on a resolution by the local municipality. Continuing, Mr. James said one of the ways by which he got results was to have the coroner's jury recommend that the level crossing be eliminated. This method seemed to get results from the railroad company. Of course, it was rather hand on the victim.

In this connection, Mr. Marston, of Norfolk County, quoted an instance: A diagonal crossing on the Michigan Central Railway had been under scrutiny, and the engineer of the county sanctioned the railroad's arrangement of providing bell and light. A farmer was killed at this crossing shortly afterwards. The first intimation that any person received was when the remains of the cutter were found in Buffalo. The light was not on that night, and the bell was continually giving trouble.

Mr. Roger, Perth County: We, as a body, should move and continually agitate that all level crossings be eliminated.

Mr. Talbot, Middlesex County: The majority of our accidents occur at what we term "safe crossings." Change of grade is the only solution.

Another superintendent instanced a case where three men were killed on a level crossing, although the train was visible for over a mile.

Mr. Blackwell: We had a fellow run into a train.

Mr. Senecal, of Prescott County, gave an instance where a freight train standing on a siding obstructed the view of a party, with the result that all were killed. The railroad was responsible for the fatality, as the brakeman was supposed to flag the crossing.

Mr. McLean pointed out that in the treatment of the subway problem, when the railroad and the county had a meeting, it was the practice in the past that the railroad was represented by its engineer and solicitor and the county by its reeve and a councillor. In such a case it was no wonder the railroad won out. The department was now supplying proper representation for the counties, and in this way hoped to get more equitable results.

Better Bridges and Culverts

Mr. Arthur Sedgewick, assistant engineer of the Department of Highways, read a paper on "Better Bridges and Culverts," dealing with those features of design which add to the comfort and safety of the travelling public and the general appearance of our highways. He pointed out that the majority of timber structures formerly used had rotted, some of them years ago, and were replaced by permanent structures suitable to the needs of those times only; now many of them were found to be too light or too narrow for present requirements. Present-day conditions of travel required that the smaller culverts be made the full width of the graded roadway, and for bridges on main roads the clear width of roadway should be 28 feet, or even 30 feet. Another point he drew attention to was that, wherever practicable, the top of the culvert should be built level with the road's subgrade, so that the road metal may extend over it. When this is done there is no break or unevenness in the surface of the highway which is so often noticeable, and which detracts so much from the comfort and serviceability of otherwise good roads. Mr. Sedgewick also dwelt on the importance of the strength and appearance of guard rails. Rails should be built that will really be a safeguard to our modern automobile traffic that does not "know the road."

Discussion on Mr. Sedgewick's Paper

Mr. Sedgewick had a number of slides thrown on the screen showing poor and good construction in culverts. He pointed out that the principal defect was in not building a culvert of sufficient length, thus contracting the road surface at this point, where it should be at least the same width as the roadway. He stated that there should be a clear distance between guard rails of at least 30 feet on a main road and at least 24 feet on a minor road. One slide demonstrating the necessity of constructing a good foundation was shown, Mr. Sedgewick remarking that this man liked to spend his money on the superstructure where he would see it, and that the collapse was the result.

Mr. Roger, of Perth County, presented a problem to the conference. In his county some 4,000 acres of low-lying ground lay to one side of a road having a very slight fall towards the roadway. This land in the wet season was practically submerged. Having no guide as to the discharge, which would be a variable quantity, he wished to know how large a culvert to build. He wished to know if the department had any formula applicable to such a problem. No such formula being in existence, he volunteered the information that two square feet of section area of culvert is sufficient to drain 100 acres where the fall is one-tenth foot in 100 feet.

Mr. McLean at this juncture remarked that very often culverts were built too small for future use, and very often engineers overlooked the fact that at some future time other ditches might be connected to the drain that the culvert is to serve.

The question as to when and where guard rails could be omitted was brought up. Mr. Marston, Norfolk County, made some forcible remarks, saying that a culvert, bridge, or crossing, was dangerous so long as there was a possibility of accident occurring. "Safety first" and "Do the job right" were his mottoes.

Bituminous Surfaces in York County

A paper by Mr. E. A. James, C.E., engineer of the Toronto and York Highway Commission, gave some interesting information regarding the work done and the methods used in the application of bituminous surfaces to roads in York County. He said that by far the greatest mileage in York County was water-bound and bituminous macadam, and in connection with the building and maintaining of these two types of macadam roads they had developed certain ideas in dealing with "bituminous surfaces," although during the last two years they had also treated gravel roads. For their own purposes they had divided bituminous surfaces into two classes—surface mats and wearing surfaces. Mr. James proceeded to explain the methods used in the application of these two classes of treatment. He said it must not be expected that surface mats would bring poor roads into good condition, but they would keep a good road from going to pieces. They prevented the attrition of the road, the lighter dust that blows over being held, and they formed an elastic cushion for the traffic, and prevented the removal of the binder from the gravel or stone. As regards the wearing surfaces, four years of testing surfaces of this type of surface showed it to be very satisfactory under certain conditions, but if the traffic is very heavy and intense a higher type of road might be required. Perhaps the bituminous macadam mixed method which was used in reconstructing Dundas Street during 1917 might fill the need. In closing, Mr. James said: "In review, our experience in York has been as follows: We commenced by sprinkling with light bitumen; we then went to heavy bitumen; to penetration methods; to mixed methods; and let me close by saying I believe that for 75 per cent. of our county roads we are going to use water-bound macadam or gravel roads with heavy surface treatments."

Discussion on Mr. E. A. James' Paper

After the reading of Mr. James' paper, motion pictures, prepared by the Department of Highways, of the road work engineered by Mr. James on Upper Yonge Street were shown. These pictures illustrated the plant used and the method of laying the materials. Replying to a number of questions, Mr. James said that no fixed rule defining where to change from water-bound macadam to bituminous-bound macadam was established, but he believed, now that the Limit of Weight Act was in effect, the character of the surface was not so particular, but that the foundation was the important matter. Water-bound macadam and brick pavements were used where the traffic did not exceed 200 vehicles per hour. Mr. Huber added to the general discussion by referring to the Eaton Road. This road was a bituminous-bound macadam road, which it was intended to dress with trap chips, but the supply of this material was limited so that only a small section of the road was treated in this manner, the balance of the road receiving a dressing of pea gravel. When the road was paved it was found that the portion receiving the trap chips was in excellent condition and had no repairs, while the portion dressed with pea gravel was in a very bad condition, showing conclusively that trap was the best dressing for the road. Messrs. Robertson, Allison, Forbes, Wheelock, and Young had all used bituminous binders, with very good results.

Mr. James particularly warned the superintendents against too lavish a use of bituminous binder, as it would make the road soft and very inclined to work into lumps and depressions. He also laid particular stress on the necessity of using clean stone, free from dust and dirt, in the top mat.

Preliminary Work on Provincial Highways

Mr. Geo. Hogarth, O.L.S., Assoc. Mem. Can. Soc. C.E., engineer of highways, Department of Public Highways, presented a paper on Preliminary Work on Provincial Highways. He pointed out that the Provincial Highways Act was proclaimed in April, 1917, and in August the department took over the control of the Kingston Road, running east out of Toronto. No portion of the road running through villages or towns was assumed by the department. Certain standards were adopted and a model design of a highway developed, special attention being paid to the subject of future maintenance. When the road was taken over it was found that some sections were in bad condition and relief measures of grading and draining were at once carried out with the result that the road was greatly improved in a matter of two weeks. In the permanent work the culverts are constructed wide, built for type "C" loading, ample drainage provided and the obstructions to the view removed. The road will be divided into convenient sections and a local man employed to look after each section.

Discussion

Following his preliminary discussion, Mr. Hogarth had shown a number of interesting slides, showing typical construction of a 66-foot and an 86-foot highway, the manner in which shade trees are mutilated by linemen, the conditions met with on the Kingston Road, and the way some of their difficulties were surmounted. An interesting feature of the work on this road was the introduction of a gravel train hauled by a steam tractor. It consisted of four special wagons, each carrying 3½ cubic yards. In order to make this plant efficient, an elevator and storage bins were installed at the gravel pit, so that very little time would be lost in loading the cars. The tractor used was steam-driven, 20 h.p., manufactured by the Buffalo Pitts Company, Buffalo, costing the department $3,600 f.o.b. Pickering, and was strongly recommended by the department.

Mr. Hogarth very strongly approved of the heavier type of grader, the department using the heavier type of Russel Reliance Grader, the main features of this machine being its durability and the handy appliance for offsetting the pole.

Mr. Hogarth was asked the procedure he followed to have the mail boxes and poles removed. Replying, he said that they generally consulted all parties interested, and came to an understanding agreeable to all. He had experienced very little difficulty, since all were interested in good roads.

Mr. Fair, Frontenac, raised the point that, in case of accident through a mail box obstructing the traffic, who would be responsible? The only answer forthcoming was that the government assumed no liability.

Mr. Talbot, Middlesex, again raised the issue that one could not distinguish between cost of construction, of which the department pays 40 per cent., and cost of maintenance, of which the department paid 20 per cent., and suggested that 33 1/3 be paid on both construction and maintenance. A further suggestion was made that the planting of trees be controlled by an act.

Mr. McLean, replying, said that the policy of the government was to remove trees where necessary and also to plant, and that legislation might be passed fixing the position of trees 32 feet from the centre of the roadway.

Clay Road Maintenance in Essex County

In his paper on "Clay Road Maintenance in Essex County," Mr. Millen briefly intimated that all knew the condition that clay roads get into during wet and frosty weather. For purposes of efficient maintenance, in his county the mileage was divided into short sections and care exercised in selecting a foreman who was vitally interested in good roads himself. In order that uniform results might be obtained throughout the county, certain instructions are given the foremen as to the method and time for grading and dragging.

Mention was made of the drains, and this led to considerable discussion after the paper had been read. Mr. Millen said that too steep a crown to a road leads to a concentration of traffic, straddling the high portion, causing, especially on a clay road, deep rutting. Interesting costs of maintenance in Essex County followed.

Discussion

In calling for discussion on Mr. Millen's paper, Mr. McLean remarked: "The personal interest of the men on the job is necessary for the maintenance of good roads."

Mr. Millen very much preferred the steel drag, claiming that an oak drag shod with steel is too cumbersome and heavy, saying that when he wished to grade a road he used a grader; when he wished to smooth it up he used a drag. Mr. McVicar, of Brant County, was strong in favor of the use of the harrow to break up and level a clay road before dragging, and quoted a cost of $30 per mile for maintenance of this type of road.

The discussion brought out what Mr. Millen called "a good wrinkle." In Essex the ditches are very deep and when they use the grader they do not go to the shoulder of the ditch but keep back about 2 feet, forming a small gutter from which they cut small channels to the main ditch. This is an excellent safety device for motorists.

Mr. McBurney, Haldimand County, has about 125 miles of clay road divided into forty sections, leaving each man about three miles to maintain. He also calls an occasional conference of his road foremen.

Tribute to Mr. Millen

Professor Laing, of the Faculty of Applied Science of the University of Toronto, to whom the conference was indebted for the university accommodation afforded them, warmly congratulated Mr. Millen on the good work he has accomplished under the unfavorable conditions prevalent in Essex County. The professor, being well acquainted with the conditions a man would have to contend with, recalled the time when the Talbot road was about the only highway worthy of being called a road, the other roads being little better than mud banks. Now all the roads are in first class condition. The conditions and obstacles a road superintendent has to contend with in Essex are very hard to explain unless a man actually came in contact with them himself. The action of frost and water and the difficulties in securing any kind of effective drainage make the problem extremely difficult. The professor mentioned seeing a four-horse team, harnessed to an empty wagon, stuck on one of the main roads, and that it was an ordinary occurrence for a man to stop every hundred yards and knock the clay off the wheels before proceeding further. The enormous benefits accruing through the operation of the new Act and Mr. Millen's efforts could hardly be measured in dollars and cents.

Mr. Huber said there had been a lot of conflicting testimony as to the kind of drag that is best suited for levelling a road. Some men contend that an oak drag, which is the heaviest possible obtainable, shod with steel, is the best; another secures best results with a drag constructed of basswood, and still another with an iron drag. The drag is used to smooth up the road, take off small lumps and fill up depressions, but not to grade the road. It is obvious that a drag suitable for one class of soil would not be as efficient in soil of a different nature.

County and Township Road Organization

Mr. W. Huber, assistant engineer of the Department of Highways, addressed the conference on the above mentioned subject, covering it in an interesting and instructive manner. He dealt with the various factors that must be taken into consideration in the organization of a road system, confining the greater portion of his remarks to the county organization, these being applicable to a great extent to the township, and he also discussed various phases of the work of maintenance and construction. Some of the points he took up were the selection of roads, appointment of a road committee, the qualifications and duties of the road superintendent, the formation of a definite programme of improvement, passing of accounts and the paying of workmen and their employment. His remarks, which are reproduced more fully elsewhere in this issue, were followed by considerable discussion.

Discussion on Mr. Huber's Paper

Mr. McLean expressed the opinion that the most efficient system of paying workmen, though involving some extra work for the county treasurer, was for the treasurer to issue individual cheques for the men. He then had a receipt in the form of a cheque and on the pay-rolls. The duties of the superintendent were on the construction of the roads and he should not be troubled with office work.

Mr. Cleminson, of Prince Edward County, said he saw no need for the county road committee to go over the roads with the superintendent in the spring. The superintendent was on the roads all the year and knew just what work was required next year. One idea he did not agree with was the apportioning of the money to different parts of the county, as this tied up the superintendent and prevented him from doing work where it was most needed. The equalized assessment system was a big drawback. Mr. Cleminson said the chairman of the road committee should be a permanent official outside of the county council, as when the membership of the committee is constantly changing, it could render little or no assistance to the superintendent. The superintendent should not hire help but should leave it entirely to the foreman and place the responsibility on him. Another point of organization that might be mentioned was the laying out of a supply of metal. The committee should secure the supplies ahead so that the superintendent can plan his work and know the length of his hauls.

Mr. Marston, Norfolk County, thought it was the proper thing for the committee to go over the roads with the superintendent each year, as the members would then know just what conditions the superintendent was up against and would be able to appreciate the work he carried out. Mr. Marston agreed that the members of the committee should not be members of the county council. When paying men in his county, the time-books were sent in to him and he made out the pay sheet. The treasurer handed him a cheque for the amount and he sent envelopes to the foremen, who sent back the signed pay-sheet as a receipt.

In regard to a suggestion that township road foremen be employed in county work, Mr. Cameron, superintendent for Stormont, Dundas and Glengarry, said he could not agree with this idea. A foreman should not at the same time carry on work for the county and the township. The district under his supervision was divided into twelve sections with an overseer for each. There was a patrolman for about every two miles and the overseer looked after all patrolmen in his section. Mr. Cameron thought the superintendent had not power enough and that he was held down too much by the councillors.

Mr. Marston thought the superintendent had the power if he used it. The road superintendent has the right of employing men and should not be interfered with by the council in that regard.

Mr. McQuigge, Renfrew County, spoke of the trouble experienced on account of the members of the road committee being changed each year. One year there might be good practical men, but the next year's members might know nothing at all about road work. The superintendent, he said, should be guided by the department.

Mr. Talbot said that the township idea, insofar as the county road system was concerned, should be got rid of, and the township lines disregarded in laying out the sections. He also said that the clause in the Highway Act regarding the equalization of assessment prevented the superintendent in many cases from distributing his work properly. Mr. McLean said that this section was put into the Act to protect townships which were left out of the system altogether. Mr. Talbot replied, however, that some townships which were included in the system took advantage of this clause to demand greater expenditures on their roads.

Mr. McLean pointed out that in some townships there was no material available for road construction, and the experience of the department was that other townships with good roads would have nothing to do with the county system as they would have to pay for work in other sections. He did not advise spending money on the equalized assessment plan. It might be done but was not necessary. The township boundaries should be cut out altogether, and the responsibility for the work left to a great extent with the superintendent.

Macadam Road Construction in Frontenac County

Mr. R. H. Fair, county engineer and road superintendent, Frontenac County, gave a short talk on macadam road construction. He pointed out that while at the present time we thought our modern methods far superior to those formerly used, there was some very good work done fifty, sixty or seventy years ago. About the year 1850, Frontenac County took advantage of the toll road system, and a number of excellent roads were built with Kingston as the hub. These roads had about a 24-foot roadway surface with good foundations. One point he noticed was that larger stone had been used than is now generally the case. This, he believed, produced a better road, as he had proved in one case by tests on two roads, showing that one which had a greater depth of stone of finer grade, did not stand up as well as another built with a larger size of metal.

Some said that the day of macadam roads was past, but he thought a macadam road with a bituminous binder was a cheap and still a very serviceable roadway. In Frontenac County there was an abundance of road building material which greatly simplified the problem of construction. Some of it was very hard, but there were various grades of a softer nature. He had found that in building a roadway from two different quarries, one of which produced a very hard stone and the other a softer material, that the soft stone consolidated more quickly and became smoother, and that it stood the traffic a great deal better than the surface built of the harder metal, which was liable to be torn up and disintegrate. He now followed the plan of mixing the hard and soft.

For carrying the stone from the crusher in the quarry to the wagons, Mr. Fair said he found small railroad cars very useful. The crusher was set up close to the face of the quarry and one track run in on each side of it, so that while a car was being loaded at the crusher, another handled the stone to the wagons. The cars used were second-hand dump cars.

Views of Macadam Road Construction

Following Mr. Fair's address, a moving-picture demonstration of the various operations in the construction of a macadam road was shown on the screen. This demonstration was filmed by the Ontario Government Bureau of Motion Pictures for the Provincial Highways Department. The pictures followed the construction of the roadway through all the stages from the placing and spreading of the foundation material to the brooming, sprinkling and final rolling of the surface. Mr. Fair passed some remarks as the views were shown. In regard to the type of wagon used for delivering material, he said he found the spreader wagon preferable to the side dump type, as it saved considerable shovelling. He also pointed out that it was very unsatisfactory to attempt to consolidate the whole surface in one course.

Asphaltic Concrete Construction on Dundas Street

Mr. R. C. Muir described the various stages in the making of this roadway. The Eaton Road section of Dundas Street was originally a water-bound macadam, which had been maintained by adding annual treatments of tar. Owing to change in volume and character of traffic it became necessary to construct a higher type of road.

The bed was scarified, rolled and a binder coat of hot asphalt cement applied to prepare for asphaltic concrete 18 feet wide with tar-bound macadam shoulders 3 feet wide. In order to secure a uniform thickness of asphalt, the area each load would cover at 2¼ inches thick was marked out and the material spread uniformly over this section. Good judgment and great care must be exercised in rolling to prevent squeezing and displacing the mixture. The joints bonding each day's work received special treatment.

Frequent tests were made of density of asphalt products used and in some cases a flux of oil was added. The seal coat applied by a "squeegee" overlapped the macadam at the sides.

The plant consisted of a Cummer portable one-car asphalt plant with a capacity of 2,000 square yards of 2-inch coating per eight-hour day. This plant was operated by steam and is equipped with drier, storage bins for sand and gravel, kettles, elevators and weighing hoppers. The organization used on this highway required 17 men and was able to turn out 206 tons per day. Mr. Muir's paper is appearing in full in our issue of March 13.

Discussion

In the discusion that followed the reading of the paper, Mr. Muir said that it was unnecessary to have grade stakes for spreading the top dressing or to use screeds for levelling. Raking with ordinary rakes was found sufficient.

Mr. Marston, of Simcoe, asked how Tarvia compared with asphalt, and it was explained that tar products were found excellent in the case of the penetration method, but gave less satisfactory results when mixed with a stone or sand aggregate.

Mr. Van Scoyoc asked how much the crown of the road varied. Replying, Mr. Muir said that the specification called for a 2½-inch crown in 9 feet, but, unfortunately, it was greater in some cases owing to the heavy roller pushing out the asphaltic concrete at the shoulders of the road. This was later prevented by banking the earth from the roadside against the macadam portion of the road. The old road had too much crown, even for a macadam road, having in some cases as much as ten inches. Mr. Muir added that extreme care was exercised in grading the aggregate in order to make a dense mixture. Three grades of stone, varying from ½ inch to ⅛ inch, four different grades of sand varying from a coarse sand to a fine sand, and very fine dust secured from stone quarries, were used.

Mr. McLean, Deputy Minister, added that the ideal bituminous surface would have no seal coat, but would be rolled smooth and have a dressing of coarse sand rolled into it. This would avoid the smooth surface and would make a much safer road.

The construction of the main street in Sault Ste. Marie was described by a delegate from that city. A foundation of flagstones was first laid. This was covered with coarse stone, and received a waterbound macadam.

Concrete Road Construction

Mr. T. H. Jones, B.A.Sc., Brantford, who was to have read a paper on concrete road construction was unable to attend the conference, owing to severe flood conditions in his locality, requiring his personal attention.

Mr. Van Scoyoc, of the Toronto-Hamilton Highway, gave a brief talk on this roadway. He said that this road was the most important link in the most important road in Canada. After motion pictures showing typical methods of laying a cement road, Mr. Van Scoyoc led the discussion on this type of highway.

Mr. Marston brought up the subject of cracks in the slabs, pointing out that a great deal of the trouble was in the foundation. Mr. Barber, of the city of Toronto, described various kinds of joints, adding that an ordinary 3/8 inch joint made of asphalt binder was as good as any.

Mr. Van Scoyoc, when asked if any serious attempt had been made to keep the Toronto-Hamilton Highway clear of snow and open for motor traffic, replied that, with the exception of two weeks, the road had been kept open, but that they had a peculiar problem in this case keeping a road open for both heavy motor traffic and for sleighs. They used an ordinary road grader, but had in mind trying out a lumberman's plow, followed by a roller.

It is probable that the department in the near future will extend this roadway to the border. The possibilities of a thoroughfare open from the United States border for twelve months of the year, and suitable for heavy motor traffic as a remedy for freight congestion, are quite apparent.

Ontario Highway Legislation

By W. A. McLean,* Mem. Can. Soc. C.E.

THE control of roads and streets throughout the province, while primarily vested in the Crown, as represented by the provincial government, is now regarded largely as a municipal function, having been conveyed to the municipal authorities by statutes of the provincial legislature. In the enacting of legislation governing highways, it is impossible to foresee all the conditions, because of this and because conditions are constantly changing and developing; amendments, and in frequent cases new legislation, are constantly becoming necessary. The Municipal Act is the basis of municipal road management in Ontario, in that it provides organization for the local government of the towns, townships, villages, cities and counties, specifying the duties and powers of the municipal councils. Municipal councils have only the powers expressly conveyed to them by act of legislature. These general powers and duties with respect to roads and streets are more specifically enumerated in articles 20 and 21 of the Municipal Act, giving local institutions power to pass by-laws with regard to the regulation of traffic and the general use of highways.

At one time acts respecting toll roads were of much importance, as numerous road companies were formed and roads built. With the development of railways and steamship lines these roads fell into disuse and became unprofitable, and were in some cases abandoned by their owners, in others being purchased by the councils or local municipalities and freed from toll. Only about ninety miles of toll road remain in the province, and the prospects are that they will disappear in the near future; hence the Toll Roads Act and the Tolls Exemption Act are of little general importance. The legislation respecting statute labor became obsolete as traffic increased and was discarded when it was found that the cash expenditure was in one case $2,800,000, against 1,100,000 days of statute labor. Later the Municipal Act was found to be lacking, in that it did not provide sufficient funds and organization to keep pace with the demands. It was unfair and impracticable that counties and municipalities should bear all the expense of keeping up roads when the traffic, through the introduction of the motor vehicle, developed until in some cases there are as many as two or three thousand vehicles passing over a road in twenty-four hours, going long distances and carrying heavy loads. Statistics show that in the average county, 80 per cent. of the traffic passes over 20 per cent. of the actual highways. Because of these conditions, counties were struggling to keep up their main arteries, getting very meagre results and neglecting roads of less importance. To alleviate this condition, legislation was passed by which the province paid 40 per cent. of the cost of the construction of the roads and 20 per cent. of the cost of the maintenance, the funds being secured from the automobile license fees. In certain cases special legislation regarding some suburban roads is enacted, by which the province pays 40 per cent., a city 30 per cent., leaving the county 30 per cent. to liquidate, while in several instances (not particularly to relieve the county, but because the traffic merits the expenditure and because the road is not in the proximity of the city) the provincial authorities take over 70 per cent. of the cost.

While roads are necessarily affected by provisions of other statutes such as the Assessment Act and the Drainage Acts, the more important statutes relating to highways are now the following:—The Highway Improvement Act; The Ontario Highways Act; The Provincial Highway Act; The Local Improvement Act; The Statute Labor Act; The Load of Vehicles Act; The Highway Travel Act; The Motor Vehicles Act; The Traction Engines Act; The Snow Fences Act; The Snow Roads Act; The Tree Planting Act; The Colonization Roads Act.

Damage Caused by Speeding

Mr. McLean, in opening up the discussion on the subject, pointed out how detrimental speeding in heavy touring cars is to the wearing surface of highways, since the shear transmitted by the driving wheels to the road crust varies directly as the square of the speed. Thus, if the shear at a speed of 10 miles be taken as unity, the shear at 20 miles would be four times and at 30 miles would be nine times as great.

The attitude of road superintendents, in general, towards motorists guilty of speeding, was probably indicated by the remark of one of those present, that "a speed artist should not be given the option of a fine, but such vandalism should be a prison offence."

Mr. McLean proceeded to explain that legislation

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*Deputy Minister of Highways.

Foundation Thicknesses Required to Withstand Various Loads

Weight of Vehicle Tons.	Tire Thickness Inches.	Allowable Weight per Sq. Inch of Tire Lbs.	Depth of Stone Fill for Different Subsoils.				
			Gravel (S. L. per Sq. Ft. 9 Tons).	Sand (S. L. per Sq. Ft. 4 Tons).	Dry Clay (S. L. 2 Tons).	Wet Clay (S. L. 1 Ton).	Quick Sand (S. L. ½ Ton).
3	3.07	650	2.33	3.74	5.98	9.05	13.40
6	6.15	650	2.63	4.87	7.92	12.75	18.30
9	9.21	650	3.16	5.65	9.20	14.40	21.80
12	12.00	660	3.46	6.10	9.60	16.20	24.80
15	12.00	833	4.20	7.26	12.00	18.60	28.20
18	12.00	1,000	4.90	8.26	13.50	20.82	31.50
21	12.00	1,166	5.48	9.25	14.65	22.50	34.60

respecting excessively heavy loading on trucks is under consideration, since the heavy loading requires an unreasonably thick stone foundation for roads. The table herewith, showing the thickness required to withstand various vehicle loads, was thrown on the screen. In a wet season, Mr. McLean stated, the conditions under "Wet Clay" are applicable to most highways. The figures are based on the assumption that the stress is transmitted at an angle of 30 degrees to the vertical.

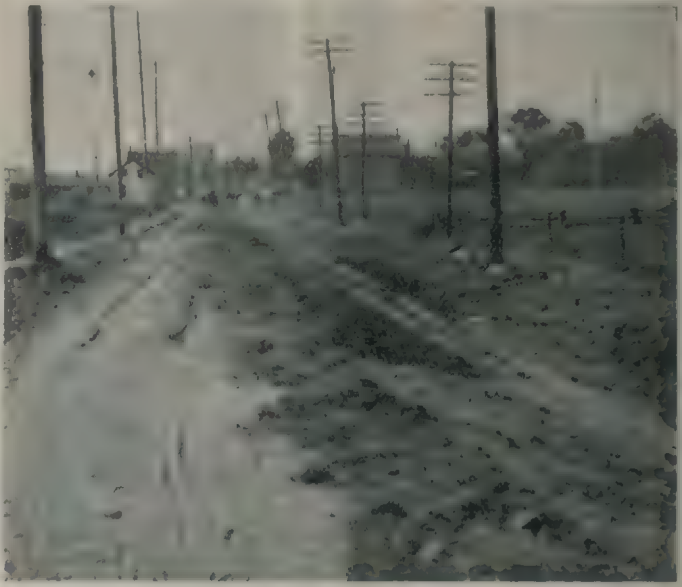
Heavy Grading of Earth Roads in Lincoln

By Mr. P. Robertson*

Previous to 1917 we had only thirty miles of county roads, that which was known as the Queenston and Grimsby Stone Road, and in 1917 we added to our then county road 130 odd additional miles of principally clay roads. A large portion of these roads was in a township which had been doing the road work by statute labor. As a rule the roads are not uniform in width nor uniform as to sub-grade; quite frequently very crooked, having in some instances been built around obstructions which existed at the time the road was laid out.

The Road Committee decided to have uniform roads—that is, roads with light traffic we would grade 24 feet from ditch to ditch and roads with heavy traffic 28 feet. When we started to grade these roads we came to the conclusion that it was impossible to do the work with teams. The Committee purchased a 16-32 Sawyer Massey oil tractor, which handled the work fine. In starting the grading of these heavy earth roads we staked the road 10 feet from the center of the road, then ploughed three furrows on the outside of the stakes, which would make the road 24 feet from ditch to ditch; we staked 12 feet from the center of the road for 28-foot road. We did not pay any attention to culverts already existing, for they were all too short for a county road, and had to be lengthened or re-built. Our plan was, in grading these roads, to make them straight and uniform. When we had the ploughing complete the tractor finished the road with five or six rounds, pulverizing the lumps and rolling the road. We used a harrow to follow the grader at first, but used a two-blade drag later in the season, and found it improved the road to a greater extent than a harrow. The sides of the ditches sloped about 1½ feet horizontally to 1 foot vertically, and the crown of the road had a rise of 1 inch to the foot from the shoulder of the ditch to the centre of the road. We cut down all hills and moved the earth to low places, improving our grades. On roads that required no hill cutting we could finish from three-quarters of a mile to one mile a day, the tractor handling a heavy grader that it would take four teams to operate.

Regarding the surface drainage on earth roads. This can best be accomplished by the use of a two-blade drag which, if used periodically after a rain, will keep the surface of the road level and smooth so that it will shed water readily on a road where the traffic is not heavy. I might say, regarding the drainage, that tile drainage at side or beneath the surface in some instances is just as essential and will give equally good results applied to earth roads as when applied to the higher class pavements and more expensive roads. The cost of operation of the grading equipment was approximately as follows: Man on tractor, $3.50; man on grader, $3.00; coal oil, $3.50; oil, $1.50; total, $11.50 per day.



Sods thrown in centre—how not to grade.

Mr. Robertson's Address

Motion pictures were shown illustrating Mr. Robertson's talk. A very interesting feature was the use of the tractor as motive power for plowing up the roadbed or sides.

The question as to the advisability of leaving the sod turned up from the edges in the roadbed led to considerable discussion. Many of the men present were of the opinion that the sod would decay. Mr. Robertson claimed that they helped as a binder, and that the cleats on the drive wheels of the tractor broke them up into such small particles that any trouble caused by the vegetable matter wasting would be so evenly distributed that it would not affect the road.

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*Lincoln County Road Superintendent.

Preliminary Work on Provincial Highways

By Geo. Hogarth, O. L. S., Assoc. Mem. Can. Soc. C. E.*

THE Provincial Highways Act was passed at the 1916 session of the Legislature, and was to take effect on a day proclaimed by the Lieutenant-Governor of Ontario. On April 10th, 1917, the Act was proclaimed, and on August 21st, 1917, a Provincial Highway was assumed through the counties of Ontario and Durham. The road thus assumed is known as the Kingston Road, and passes through the southerly portions of the Townships of Pickering, Whitby, Whitby East, Darlington, Clarke and Hope. No road was assumed in the towns of Whitby, Oshawa, Bowmanville or the village of Newcastle. All structures on the assumed road were taken over, and a careful examination made to determine what repairs, if any, were required to make the structure safe for public travel.

When the road was assumed certain standards were established for width of roadway and cross section of ditches. The width of right-of-way in different parts of the road as fenced varied from about 40 feet to nearly 70 feet, and while a definite width of roadway and ditches was decided upon, the question of total width of road allowance was left open for further consideration. Two designs for a road allowance have since been drawn up, one for an allowance 66 feet in width, and a second for an allowance 86 feet in width. It was found that the 86 feet width was required to provide for everything essential to public highway; that is, the surface of the roadway, the ditches, telephone lines, power lines and a bordering of trees. The width of roadway adopted was 28 feet, and provision is made for widening to 30 feet at some future date. In addition to the establishing of roadway standards a pamphlet of regulations was issued governing the construction and maintenance of telephone and power lines on such highways.

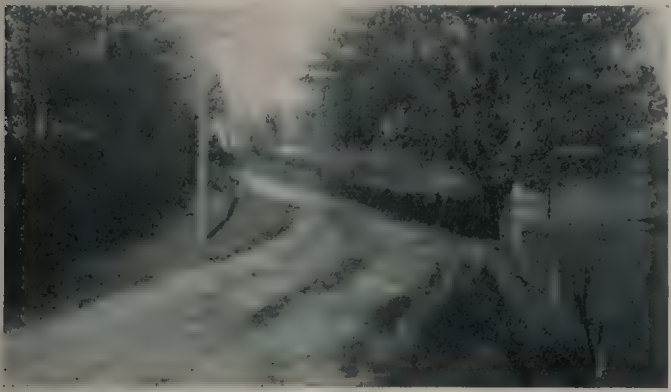

Fig. 1—View of road obstructed by shrubbery, etc.

The Maintenance System

When taking over the road it was considered that a comprehensive system of maintenance of the highway would be inaugurated. This has been carried out, and last fall every preparation was made by proper ditching, drainage and gravelling, to place the road in such condition that next spring one man will be able to keep a section of some length in a good condition of travel. To round out a good maintenance system requires that proper attention be given to the safety of bridges and culverts, and in some cases this involves the rebuilding of structures which are beyond repair. The maintenance system has been gauged to provide for the traffic passing over the road, and a surface is being developed so that the ordinary operations of grading and split log dragging will keep the road in good condition. Several sections of the Provincial Highway had been gravelled from time to time by the townships before the province took over the road. These sections, while under township management, had only statute labor applied to them, and were in fairly passable condition, thus proving that the gravel road may give satisfaction until such time as increasing traffic demands a stronger surface.

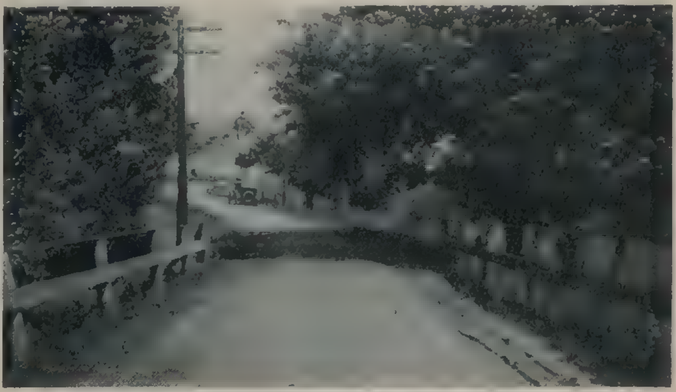

Fig. 2—Same as Fig. 1 made safe for travellers.

With this precedent as a guide it was decided to gravel the road over those sections which were most in need of such material. This condition was met with over the greater length of the road, and a gang was put on in each township to haul and place gravel. The roughest sections were first gravelled, and as work progressed and as more teams were available it was possible to gravel or patch a fair percentage of the length of the road.

Before work was commenced there were two sections of the road which were so rough that it was impossible to drive at a greater speed than four or five miles per hour. Two or three weeks after work was commenced these sections were comfortable to ride over and several weeks later, when traffic had consolidated the gravel, the entire road could be travelled from end to end in comfort and at a fair rate of speed.

While gravelling was begun as soon as the road was assumed, the grading and rounding up of the surface was not lost sight of, and a light grader was purchased. This machine was used to cut off the shoulder and cast it out towards the ditch, thus giving a rounded up section which shed water. A heavy grader built to be drawn by a 20 horse power tractor was later bought, as better results were more rapidly obtained on some sections with the grader than by gravelling. The heavy grader when drawn by a tractor proved to be a time-saving device and, being powerful and well built, no time was lost from breakages and repairs.

Several sections of the road were early marked out for improvement of the drainage and ditching. These sections were on long hills in cuttings where the original roadway had not been excavated wide enough. Little or no provision for side ditches had been made and the water during rainstorms followed down the centre of the road. Drag scrapers were employed to move a large quantity of material, and in this manner a wide cross-section was made with side ditches about 2½ feet deep. On one hill where the haul was quite a distance, the earth was moved with carts and used to widen out a narrow fill in the valley. The completion of this work made a marked improvement in the roadway and completely eliminated wet spots and springs which formerly occupied the centre of the highway.

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* Engineer of Highways, Ontario.

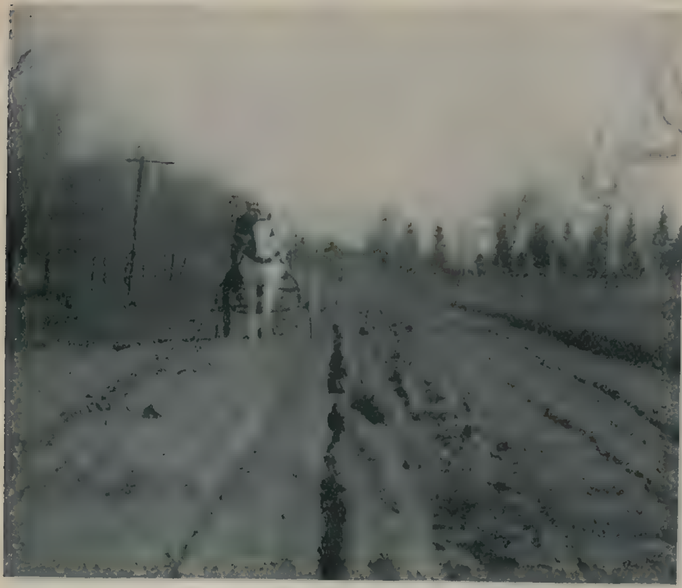
Fig. 3—Welland County road before improvement.

The ditches during this winter also gave evidence of being able to intercept water flowing off the hills and so prevent it flowing onto the road and creating bad ice conditions. The evidence to-day is that the road in a cutting having deep side ditches is dry, and the road with inadequate ditches is covered with ice. One hill which was widened and improved with deep ditches had always been soft and troublesome to maintain. When opening the side ditches a spring was discovered half way up the hill in the north ditch and a drain tile emptied under the road at the south side. Water flowed continuously in these side ditches after they were opened, and the action of this section of road will be carefully watched during the thaw this spring.

The examination of the bridges and culverts showed that some attention was required immediately. Water flowing down the road and through the floor of the bridge had undermined a large abutment to a considerable extent. This excavation was filled with field stone, and steps taken to divert the water so as to prevent further damage. A nember of timber culverts were in an advanced state of decay, the wood being eaten up with dry rot. Concrete culverts replaced these structures, and ample opening was allowed in all new structures.

Culvert Construction

One point with reference to all culverts is that they are built the full width of the roadway and not less than 30 feet is allowed between the inside faces of end walls. This gives a roadway unobstructed by handrails and guardrails and removes to a great extent the danger of accidentally running over the end of a short culvert. The roadway is graded over all culverts and at least six inches of gravel placed on top of the concrete slab.

Several steel bridges are on the highway. They are all of light construction and not suitable to the heavy loads passing over the highway to-day. It is expected that one of these bridges will this summer be replaced by a substantial concrete culvert of ample opening, and in that manner a narrow roadway and dangerous turn will be eliminated. All new bridges and culverts are being built to carry class "C" loading, the concentrated load of which is a 20-ton road roller. The clear width of roadway on all through structures will be 20 feet, and sidewalks, wherever provided, will be 6 feet in clear width.

In this connection it might be well to state that automobile moving vans and heavy motor trucks from Toronto and Hamilton are continuously passing over the highway. Some of these trucks are more than 9 feet wide, and when loaded weigh up to 15 tons. This traffic has been forced onto the highway and is rapidly increasing. A motor truck will take a load of goods idrect from a factory or house in Hamilton or Toronto, and deliver them at their destination in Whitby, Oshawa or Bowmanville in a few hours. This is almost as quick as the material could be loaded onto a freight car and two handlings, with consequent damage, are saved if the goods are taken by motor. The motor trucks on the highway are rapidly increasing, and this business should develop wonderfully during the coming summer.

Bad Turns Eliminated

In several places the view in travelling the highway was very much obstructed due to trees or sharp turns hidden by bushes and other obstructions. One turn which was nearly a right angle, was so obstructed that no view of an approaching vehicle could be obtained until the cars approached within a very short distance of each other, and the turn combined with the blinded view made the corner particularly dangerous. A small piece of property was obtained to round off the corner, a number of telephone poles, stub poles, guard rails, fences and rural delivery boxes were moved away and the entire corner was opened up so that a good

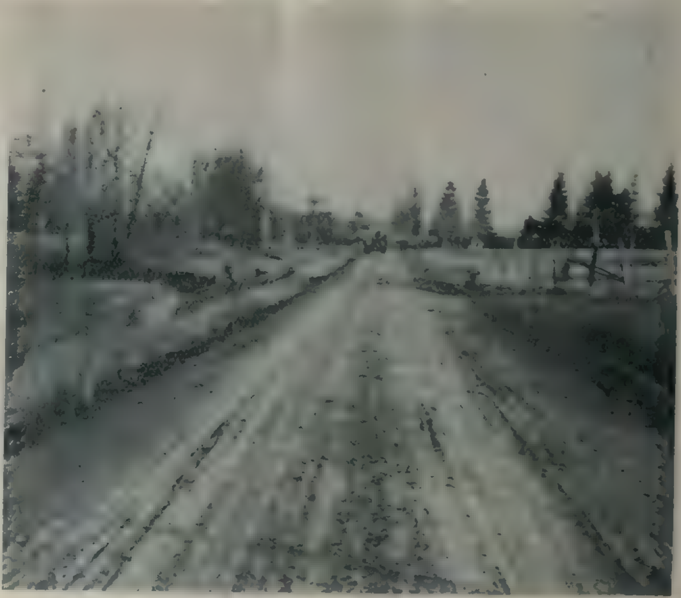
Fig. 4—Same as Fig. 3 one year later.

vision is obtained, and the danger of accident is avoided.

Two steam tractors were purchased for hauling the graders and handling trains of three gravel wagons, each wagon having a capacity of 3½ cubic yards. Steam power was selected because of simplicity, ease of repairs and the possibility of obtaining local help to operate steam engines as against experienced mechanics being required to operate any other kind of power. These engines operated continuously for about three months, after which one was used to heat gravel for a culvert that was started late in the fall. No difficulty was experienced in keeping these machines in operating condition, and they gave good satisfaction. In order to keep the boilers in proper condition they were washed out at the end of each week.

A system of maintenance is being considered for the entire road for the coming summer. The road will be divided into convenient sections and a local man employed to look after each section. The section man will have a split log drag and will be expected to keep the road and ditches open and apply gravel from convenient pits as may be required.

Snow blockades on the Provincial Highway have not been frequent or serious this winter, the reasons probably being that the road runs roughly east and west, and wire fences exist over the greater portion of the distance. One short section which runs north and south was filled up with snow due to a snake fence and an orchard on the west. Isolated drifts have formed in a number of places but no difficulty was encountered in quickly opening the road for travel.

County and Township Road Organizations

MR. W. Huber, assistant engineer of the Highways Dept., addressed the conference on the above mentioned subject, dealing first with the county organization. He pointed out that organization meant the bringing into active connection and co-operation of a number of parts, and it was because of their efforts in this direction that some contractors were able to make such a success of their business and to carry on their work so efficiently. Likewise, in county road organization this idea must be kept uppermost, and the various units must work in harmony with one another.

The first factor that must be taken into consideration was public opinion. Unless the good roads project had the public backing it, no real progress could be made. The next step was the selection of proper roads. The county should not be expected to assume too many highways at one time; the less they started with, the better would they be able to work up their organization and carry out the preliminary work. After the organization is properly formed, its scope can gradually be extended as seems advisable. The roads chosen should be the main market routes. Another very important factor was the attitude of the county council. It was absolutely necessary that the councillors should take a broad-minded view of the matter and remember that they are working for the county as a whole and not for the various municipalities to which they may belong, if operations were to be carried on in a systematic and well-ordered manner.

Appointment of Road Committee

The road committee, Mr. Huber said, should be comparatively small, comprising perhaps from three to five members, who have sufficient time to devote to the work. The committee should keep in close touch with the work and meet often, and with a small number this could be more easily accomplished. There were many details in connection with the system that the committee could attend to without reference to the council, such as the ordering of material, buying of machines, etc.

A Road Superintendent's Qualifications

A road superintendent must be a man of fairly good education and capable of carrying on ordinary business transactions, as well as having practical experience in road work. He should be permitted to carry on operations without local interference. If a county councillor wants to make a complaint, let him do so through the road committee. As far as the selection of foremen is concerned, this ought to be absolutely in the hands of the superintendent. There was some difference of opinion as to the engaging of men by the foreman. However, if the foreman is a first class man he should certainly have this privilege.

It is beneficial, if possible, to engage gangs of men for the season, as even though the work be unskilled, the men improve considerably with experience. Frequent dismissal and re-engaging of workmen should be avoided as far as possible. Sufficient wages should be paid, as the contentment of the men in this respect contributes greatly to the success of the work.

Definite Programme Necessary

Work on a good roads system should be carried out according to a definite plan—not merely for one year—but a programme of construction work should be laid out covering a term of years, perhaps ten or more, necessary to complete the system. Operations should be carried on in such a way that each step would fit in with the next. It is also possible to plan ahead for maintenance work, even though it be only for one year. After the roads are assumed, the first thing to do is to put them in passable shape. Sometimes townships, knowing what roads the county proposes to take over, will purposely neglect them and they fall into very bad condition. The distribution of the work over practically the whole system at the beginning is likely to create a favorable impression and win over some who may have been opposed to the system.

In carrying on maintenance, the work should be divided into a large number of sections, and each section should have one man over it acting in the capacity of working foreman. This organization might also extend to snow shovelling. If the superintendent keeps a close watch on the maintenance foreman, he can pick out the most likely men for construction foremen, which position demands the better class men.

In the spring the entire system should be graded. If this is done properly, the roads can probably be maintained in good condition by systematic dragging. It is of considerable importance that a sufficient number of drags be provided, as it wastes time and tends to the dissatisfaction of the foreman if he has to go a long distance to obtain his implements. The maintenance foreman should attend to the filling of holes on the roads, clearing of drains, cutting of weeds, repairing of bridges and culverts, etc. He should receive special instructions to examine the roads after heavy rains, as this was the time when trouble was most liable to arise.

In laying out the programme for the year's work, a tour of inspection should be made as early in the season as possible, by the road committee and county superintendent. This served two objects. Roads are thus seen at their worst and an intelligent estimate can be formed of what must be done during the year. In the earlier years after the system is assumed it would be well to make an examination of bridges and culverts to see what repairs and renewals were required.

Contract Work and Day Work

For ordinary roads such as stone, rubble or earth, day labor was preferable. On the higher types of road, such as concrete, bituminous concrete, bituminous macadam, where considerable skill was required, contract work might well be considered.

Machinery should be used to as great an extent as possible. Hauling and grading are two items on which labor costs may be thus cut down. There should also be sufficient machinery to carry on work at a number of different points. Approximately ten years is considered a reasonable time in which to complete a county roads system and it is figured that one outfit will construct five or six miles per year. In that way one roller would complete about 60 miles in ten years, and there should therefore be one roller for every sixty miles. It is important that the work be arranged so that all machines should be working to capacity.

Mr. Huber pointed out that the provision of road camps right on the job might be of considerable advantage in keeping the men permanently employed, as they would always have accommodation no matter in what part of the county work might be going on. It would also be the means of saving many a half day's work in wet weather.

To stimulate interest in the work, good conditions and wages were necessary. It might perhaps be well to let the foremen know that their work was being compared, but this was not advisable as a rule in the case of the men. Having material hauled by contract might be useful in hurrying up work.

There was a certain amount of work that the superintendent could look after in the winter time. Material could be purchased and delivered; field stone could be hauled to the road side and piled ready for crushing in the spring. The overhauling of machinery should also be done in the winter, so as to eliminate as far as possible all trouble with it during the working season. In this connection it was well to put all machinery in charge of a capable mechanic and make him responsible for its upkeep.

Passing and Paying of Accounts

All accounts should be submitted directly to the road superintendent, as he was in a position to classify them and to state on what part of the road system they were chargeable. He should show just for what purpose every item was appropriated. These accounts should then be submitted to the county road committee, and if they were satisfied, should be handed on to the county treasurer.

There were quite a number of systems of paying workmen. The whole amount might be handed to the superintendent and he might distribute it among the foremen, or pay the men direct; also the money might be handed to the foremen in the first place or sent to the men direct. One system which might prove satisfactory and save trouble, was to submit the total amount to the bank and let them make up the envelopes and pay the men.

Township Organization

With regard to township organization, Mr. Huber said that, just as in the case of the county, the problem was one of producing co-ordination and co-operation in the carrying out of the work. The first step, therefore, was to place the work in the hands of one man. The old system of statute labor and employment of pathmasters lacked this element of co-ordination. If path-masters must still be employed, it would be well to place them under the supervision of a road superintendent. Statute labor might possibly be used for the hauling of material.

In closing, Hr. Huber stated that the department was at the disposal of the road superintendents and it was its desire to assist them in every way possible.

Fireproofing Wooden Buildings

In these days of shortage of material, particularly of steel, it is interesting to note that practically permanent buildings may be erected of wood, covered with large sheets of asbestos building lumber, manufactured in various thicknesses of asbestos fibre and portland cement. Not only is this material fireproof, but it is practically indestructible from ordinary wear and tear and is a good non-conductor. Existing wooden buildings also may rapidly be transferred into practically fireproof buildings with an appearance that is decidedly improved. Churches, hospitals, residences, factories, schools, and almost every class of building have been lined with this material instead of with lath and plaster, on account of the additional fire protection and also because it is vermin and moisture-proof, and does not crack and fall as will ordinary plaster. It has been in use for a number of years as a lining for boiler and engine rooms in wooden vessels, and where there is any possibility of fire it is frequently adopted as a part of the general movement for the conservation of existing materials. The material may also be obtained in shingle form, various sizes and shapes. These goods are made in Canada. Full particulars may be obtained from the Asbestos Manufacturing Company, 809 Drummond Building, Montreal, Que.

Experiments carried out by the Royal Technical Institute, Italy, have led to the conclusion that lignite alone cannot suffice as a good combustible for steam-producing purposes. Trials were made with lithanthrax mixed with fine lignite dust and shaped into briquettes in a proportion of two-thirds lithanthrax and one-third lignite, bound with tar. These were found to be fairly satisfactory and efficient enough for locomotive use.

An order-in-council dated February 21 changes the name of the Marsh and Henthorn Company, Limited, of Belleville, Ont., to the Marsh Engineering Works, Limited.

Bituminous Surfaces in York County

By E. A. James, C.E., Mem. Can. Soc. C. E.*

THE title of the subject assigned to me suggests that I am expected to deal with surface treatments only, but if you are to receive an adequate conception of bituminous surface treatments in York County, it will be necessary for you to understand the construction work leading up to surface treatment, and the conditions which make this treatment, whether heavy or light, necessary.

First, let me state, however, that we do not consider dust laying surface treatment. Dust laying and dust prevention are two distinct problems, and we take it that it is with dust prevention that we are here concerned.

Tar surface on water bound macadam, Kingston Road.

The Good Roads movement in York was a matter of debate long before the motor became a common vehicle on our roads, but it was the motor car that compelled this district to improve their roads.

There were seven stone roads leading out of Toronto into York County, and with the coming of many motor cars, the old method of reconstruction and maintenance fell down, and travel on these roads became well nigh impossible.

The city and county united to improve conditions, and in 1911 a serious attempt was made to improve the main county roads that lead to the city of Toronto.

All known types of road were considered, and almost all kinds built, but by far out greatest mileage is water-bound and bituminous-bound macadam, and it in connection with the building and maintaining of these two types of macadam roads that we have developed certain lines in dealing with "bituminous surfaces," although during the last two years we have treated gravel roads.

For our own purposes we have divided bituminous surfaces into two classes:—(a) Surface mats; (b) Wearing surfaces.

It must not be expected that surface mats will bring poor roads into good condition. They will, however, keep a good road from going to pieces.

Whether the road be gravel or water-bound macadam, it should be well drained, well built and properly crowned to shed the water easily, as water tends to deteriorate a bituminous mat.

If, however, the road has become worn, it should be properly repaired before it receives surface treatment. If a gravel road, by adding gravel and loam; if a macadam, broken stone bound with bituminous binder.

Each strip of road requires different surface treatment, depending upon the traffic it has to carry; the character of the material used in construction, and its previous treatment. So you will readily see that methods described here are only general, and must be modified to suit local conditions.

Surface Mats

In a general way our method is as follows:—

First, sweep the road with a power broom and have a man with a stable broom follow to clean off any incrustation or clean out depressions that the power broom might miss.

If it is the first treatment the road is to receive we use a light material, thus securing better penetration, and your succeeding treatments appear to revive the bituminous substance to the depth of the first penetration. Some have said penetration is not possible or necessary, but we have found it always possible and highly desirable.

Asphalt oil on water-bound macadam, Yonge St.

In mat surface treatment we only cover one-half of the road at one time. This makes it possible for cautious and careful teams and motor drivers to keep out of the bitumen.

When possible we keep the traffic off the material for several hours, and before the traffic is allowed on the road we sprinkle the treated surface with a sharp sand.

Do not sweep back the dust you cleaned from the road, it absorbs the bitumen, whereas the sharp sand and pea gravel allows it to penetrate while keeping the traffic out of the bitumen.

The first application will require about one-third of a gallon of bitumen per square yard, and it requires to build up the mat about one cubic yard of sand for each 250 square yards of road.

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* Engineer to the Board of Highway Commissioners, York County.

By having a man follow the oil wagon with a stable broom to spread out possible puddles of the material and by the proper use of sand and pea gravel, you can cut your use of bitumen so as to more than pay for the sand. Last year we cut down both the quantity of sand and the cost of applying by equipping a couple of hoosier wagons with boxes and rollers underneath to spread the sand. We find, however, that whether you use spreaders or put the sand on with shovels, a man must go over the road the next day to re-spread the sand where the bitumen has been bleeding.

The second and succeeding years clean the road in a similar manner, but use a heavier material, which may be applied in less quantity.

You will usually find that the quantity of material required depends on the kind of spring. If the snow goes early and spring is slow in coming, your bituminous surface will get all chopped up and will finally be washed away.

We always apply our bituminous material hot. It spreads more evenly and penetrates better, and, of course, if you want penetration do not apply when the roads are wet.

You will have noticed this, however, that your clean-swept, firm roads are dry when the other roads are wet.

These successive applications will build up a bituminous carpet that will take both heavy and constant traffic, so that the stone of your road does not wear down, and is, after five years' use, apparently as good as when first placed.

These carpets or surface mats serve several distinct purposes. They prevent attrition of the road; the lighter dust that blows over is held. They form an elastic cushion for the traffic and prevent the removal of the binder from the gravel or stone.

Bituminous surface, penetration method, after three years' wear—Kennedy Road.

Wearing Surfaces

While we have many miles of surface treated roads that were economical to build and cheap to maintain, there has been a disposition to experiment with a type of road that would not require annual surface treatment. We in York thought at one time we could keep our roads up to standard by surface treating every other year. This we found was very poor economy, so we took up the question of a semi-permanent bituminous surface.

Our first venture was with a bituminous macadam penetration method, and each year since 1914 we have added a limited mileage of this type of pavement to the system. The base is built as for water-bound macadam, but with less crown. Then 1¼-in. stone, varying in depth from 2½ in. to 3½ in. is carefully spread, and into this hot bitumen is sprayed at the rate of 1¾ gallons per square yard. This is then sprinkled with ½-inch stone chips and the road consolidated. As a seal coat this surface is then sprayed with a lighter bitumen and again sprinkled with stone chips.

The wearing surface thus presented is good for some four or five years, when it will have to be again surface treated with the light bitumen and fine stone.

Four years of testing surfaces of this type leads us to believe that under certain conditions this surface is most satisfactory, but if the traffic is very heavy and intense a higher type of road may be required, and perhaps we have this in the bituminous macadam mixed method, which was used in reconstructing Dundas Street during 1917.

Dundas Street was improved in 1909 through the co-operation of the Ontario Department of Highways, Sir John Eaton and the Township of Etobicoke, and the section thus improved became known as the Eaton Road.

This road was built, having in mind, as I take it, the preponderance of iron tired, horse drawn vehicles, and gave good service until the traffic changed and the rubber tired, self-propelled vehicles became almost the only traffic.

For this new condition the bituminous surface mixed method was adopted, and Mr. Muir will tomorrow describe the method of construction.

In review our experience in York has been as follows: We commenced by sprinkling with light bitumen, we then went to heavy bitumen; to penetration methods; to mixed methods, and let me close by saying I believe that for seventy-five per cent. of our county roads we are going to use water-bound macadam or gravel roads with heavy surface treatments.

Defining the Status of the Engineer

(Concluded from page 178)

at least until such time as the matter had been passed upon by the various provinces.

It was finally moved by Mr. Corriveau, seconded by Mr. Murphy, that the Ottawa branch approve the efforts of the Calgary branch to obtain legislation to define the status of the engineer in Canada and that a copy of this resolution be referred to the general secretary in Montreal and to the Calgary branch. This was carried unanimously.

It was also moved by Mr. Dick and seconded by Mr. Uniacke, and carried, that a special committee be appointed to study the whole situation and report to the Ottawa branch, this committee to consist of Messrs. Corriveau, Smart, Dick, Chairman Gale and Secretary Challies.

Mr. Dick, chairman of the Proceedings Committee, made an announcement regarding the luncheon and evening meetings that had been arranged for in the near future, and referred particularly to the paper to be read by Mr. J. Blizard on Thursday evening, February 28, on "The Availability of Energy as the Source of Power and Heat."

Better Highway Bridges and Culverts

By A. Sedgewick*

IT must be apparent to all who travel the roads with automobiles that both bridges and culverts should be built wider than we were accustomed to before the automobile came into general use. They must be built wider for the same reason that our more important roads are built wider—to give safety and comfort and to expedite traffic.

In spite of all that has been said and written about the economy of good roads, to my mind the supreme reason for having them is the comfort and satisfaction they bring to those who use them, whether it be for business or pleasure. The farmer may safely be trusted to market all he is able to produce, whether the roads be good or bad, and the expense of doing so will not enter much into his calculations. But no matter at how little he values his time, he does find it most disagreeable to use bad roads, whether for business or for pleasure, if the latter were possible, as all country-bred people know. We, therefore, demand good roads, not only because they are necessary from an economic point of view, but, like good houses and good clothes, they add to our personal comfort and satisfaction, and have a beneficial effect on our minds and to our manner of living; in other words, they most materially affect our civilization.

Now, the bridges and culverts are an integral part of the road itself, and if it is necessary to widen and improve the road, the bridges and culverts should be widened and improved also.

Unfortunately, the majority of the former timber structures rotted out; some of them years ago, and were replaced by permanent structures suitable to the needs of those times only. With the improvement and widening of the roadway, made necessary by the advent of the automobile and heavier traffic, resulting from the general prosperity, we find many of these structures too light or too narrow for present requirements.

Too narrow bridge and dangerous approaches.

Present-day conditions of travel are such as require that the smaller culverts be made the full width of the graded roadway, and for bridges on main roads the clear width of roadway should be 28 feet, or even 30 feet.

The fact should be kept in mind that for such main roads automobile traffic is fast becoming the governing factor.

While the volume of such traffic on on Ontario roads is far from being as heavy as such traffic on similar roads in the states bordering on us, present conditions over there may be taken as a safe indication of conditions that will prevail here in the early future; and, as these structures are, or at least should be, permanent in a very strict sense of the word, we should, in building them, follow, as nearly as may be, present practice over there.

A neat-looking guard rail.

Building a culvert the full width of the roadway is not so much more expensive as at first thought it would appear. By doing so the cost of wing walls and guard rails will be largely eliminated, thereby partially compensating the increased cost of the longer covered opening.

Wherever practicable, the top of the culvert should be built level with the road's subgrade, so that the road metal may extend over it. When this is done there is no break or unevenness in the surface of the road, so often noticeable, and which detracts so much from the comfort and serviceability of otherwise good roads. Longer span culverts and bridges cannot be built in that way, since the weight of road metal on the bridge floor would greatly increase the stresses in the bridge members, thereby unduly increasing the cost. In such cases the condition referred to can be relieved by bevelling the back of the ballast wall, which will help to prevent the gravel from working back from the wall.

After a bridge is built and the approaches graded, considerable time must elapse before the earth approaches become firmly settled. The logical thing to do would be to properly level them up from time to time, as required, until all settlement has ceased. But this is seldom done. Either the new fill is left at about the proper level, which, after settling, leaves a depression which remains full of water, or else an excess of material is put on to allow for the anticipated settlement, the amount of which is hard to estimate and is always variable. This is the cause of the prevalent bump felt at the end of the majority of country bridges. It should be the duty of road maintenance organizations to keep these conditions remedied.

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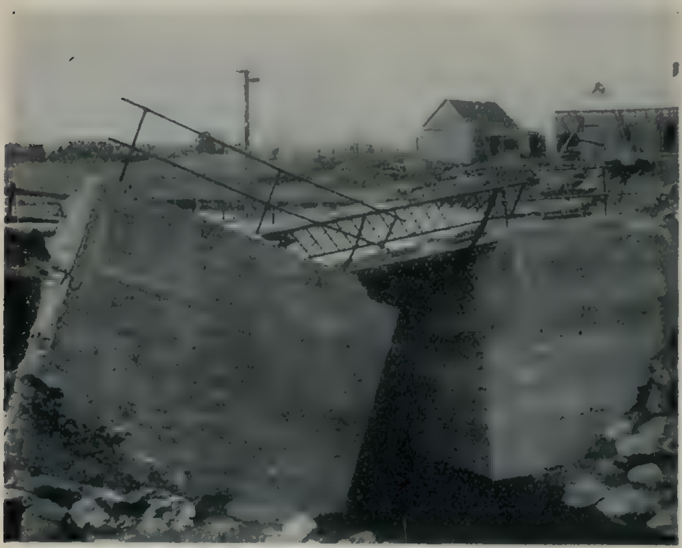
*Assistant Engineer, Department of Public Highways, Toronto.

The strength and appearance of the guard rail is becoming very important, and will be even more so in the future. The advent of the automobile has changed the requirements entirely. With horse-drawn traffic both horse and driver generally "know the road," as we say, so that accidents on bridge approaches used to be a rarity. But the automobile having such a wide radius of action, such conditions no longer hold, and it therefore becomes necessary to construct guard rails of a type that will really act as a guard under modern traffic conditions.

A great many guard rails have been built out of light wrought-iron pipe, 1¼ or 1½ inches in diameter. While this material may have answered the purpose in days gone by, it is no longer commendable for present requirements. While this light type of construction is undoubtedly cheap and lends itself to rapid erection, the many instances of broken pipe railing on the approaches of short bridges show clearly that such types are subject to as easy and rapid destruction as construction.

We should bear in mind that the normal width of the highway is subjected to an abrupt contraction at every bridge site. This condition is certainly a menace to everyone travelling on a strange road at even a moderate speed of, say, twenty miles an hour, more particularly if it be at night.



Failure due to shallow abutment footings.

It is, therefore, our manifest duty to guard all bridge approaches with railings which will not only be strong enough to stop a car if hit by one, but they should also be of a type that will make themselves readily visible, and thus serve as a warning at night of their own existence.

It seems apparent that both the public and law courts are becoming less willing to accept the lack of repair of roads and bridges so prevalent in some municipalities. If this be true, the municipality will, in the future, find it more economical to properly protect the public than to have the money eaten up by law costs.

Without a doubt, when reinforced concrete bridges are built, the guard rails should be of the same material. Such railings can be made strong, of good appearance, and because of their color and comparative massiveness are easily distinguishable to the traveller. Their cost will depend largely on the degree of refinement which is demanded in their appearance.

Most steel bridges require a steel guard rail. On the more important roads a latticed railing is desirable for both the increased protection and better appearance required. For the less important bridges, wrought-iron pipe railings, running through posts of of angle iron or tees, are both cheap and serviceable. In either case, however, reinforced concrete work may be used with good effect on the approaches.

So far as the ordinary country bridge is concerned, the guard rails and copings are the most conspicuous part, and therefore effect the appearance of the structure as a whole. When concrete is being used, we should, therefore, take precautions to ensure a neat and workmanlike finish and appearance. Already the country is dotted with a class of work which will remain a perpetual eyesore to those using the roads. The cause is lack of experience on the part of the contractor, or to his necessity for doing cheap work. The guard rail is usually the last part of the work completed, and in the hurry to get away to a new contract it seldom receives the attention its importance demands.

Municipalities having much of this work to do will ultimately find it cheaper and more satisfactory to put it into the hands of experienced and reputable men, rather than let the work indiscriminately to the lowest bidder regardless of his qualifications.

Having regard, of course, for the class of labor usually obtainable for these comparatively small works, the design of a concrete hand rail should be kept to plain and simple lines. More pretentious designs, which may look excellent when shown on the drawings, cost more than the average municipality is willing to spend, and the actual results obtained are usually very disappointing. On the other hand, the solid parapet wall which is sometimes built has a very cumbersome appearance. A guard rail built of open rails or spindles can be built amply strong, and, if built with proper care, will have a very pleasing appearance. Municipalities having much of this work to do should purchase a set of permanent moulds for this kind, which they can loan to their contractors when necessary.

Western Ontario Clay Workers' Convention

The Western Ontario Clay Workers' Association held their twenty-first annual convention at London in the Builders' Exchange premises, commencing February 27. It was decided to ask the government for some form of relief in connection with the fuel and labor problems which were handicapping the tile manufacturers to such a great extent, on the ground that tile is essential to greater production. The following officers were elected for 1918: President, C. S. Parker, of London first vice-president, James Holmes, of Alvinston; second vice-president, Gilbert Armstrong, of Fletcher; secretary-treasurer, Alfred Wehlmann, of Cairo; Mr. Wm. McCready, of Lyons, to be the remaining member of the executive.

A resolution was recently passed in the Ontario Legislature whereby a further sum of $1,000,000 was appropriated for highway work in the province. Hon. Finlay Macdiarmid, Minister of Public Works, stated that out of $3,000,000 set aside previously, $2,725,000 had been expended.

Municipal Drainage as Related to Highway Construction

By G. R. Marston, C. E.*

WATER is the natural enemy of all roads, and it is essential that it be kept off of them, out of them and from under them; this gives us three distinct drainage systems; the first to carry the water off of the surface of the road to the surface ditches at the side of the road; second, carrying the water away by means of side ditches, and third, carrying the water away in the subsoil by means of the draining.

One of the first problems that faces a road superintendent is what to do with the water; he may dig surface ditches or lay the tile, but where will he take the water? This is where the value of municipal drainage as related to highway drainage appears.

The Legislature of Ontario has provided two Drainage Acts which affect the highways of this province, the one known as the Municipal Drainage Act, and the other known as the Ditches and Water Courses Act. The first Act is to deal with large and expensive drainage schemes, the second to deal with less expensive schemes, with an allowable expenditure not to exceed $1,500, and it is the Ditches and Water Courses Act which will be found so beneficial to road superintendents in their task of drainage. In order that we may understand the value of this Act, it might be well to consider the condition which we would be in without its provision. The following judgment was given some years ago. "The doctrine of dominant and servient tenements does not apply between adjoining land of different levels so as to give the owner of the land of the higher level the legal right as an incident of his estate to have surface water falling on his land discharged over the land of lower level, although it would naturally find its way there. The owner of the land of the lower level may fill up the low places on his land or build walls thereon, although by so doing he kept back the surface water to the injury of the land of higher level." I believe legally there is no exception to this in case of a water course, but what is a legal water course? You will always find considerable contention about this matter, but a study of various cases which have been tried in the courts will lead to the following definition for a water course: "Wherever water has created for itself a defined channel with visible banks or margins within which running water may be found during at least certain seasons of the year in sufficient volume to be of service to the proprietors of the adjoining lands, a legal water course exists, providing always that the flow of water comes from some natural and reasonably constant source, and is not due to some exceptional or unreasonable event. Now unless we are able to make use of a defined water course it would seem to me that we have no right to drain the roads without proceeding in a legal manner by means of the drainage acts provided by the Legislature."

Drainage Acts Not Thoroughly Understood

In the drafting of the Ditches and Water Courses Act, Parliament has defined who should have the right to proceed under the Act, and while no doubt the Act was provided originally for the drainage of farm lands and the proceeding should be commenced by the owner of land, in the definition of owner there is included a municipal corporation as regards any highways or other lands under its jurisdiction, and it has been held that "What the Act does is to confer on a municipal council the same rights and impose the same liabilities as are conferred and imposed on an individual owner." I venture to suggest, with all due respect, that the drainage acts have not been thoroughly understood by the councils of the various municipalities; that if they had we as road superintendents would not be confronted with the question of large and deep ditches along the highway which are a danger to the travelling public, and which must be protected by means of guard rails or run the chance of an accident occuring and the county probably having to pay heavy damages. This indiscriminate digging of ditches along the roadside, has been brought about by the idea that all the owner of land had to do was to ditch his land to the road and then inform the municipal council that they had to dig a ditch down the road to accommodate him, and I am sorry to say that they usually did it.

We must remember that the municipalities have the same rights as owners of the roads as the individuals owning land, and that no man has the right to ditch his land and damage the highway; neither has the municipality the right to drain the road to the detriment of an adjoining owner.

Where are our interests as road superintendents affected? In this way: In 1915, the Legislature amended the Highway Improvement Act by adding the following clauses:

"The engineer or road superintendent appointed by the county council or by any commission under the Highway Improvement Act, may without a resolution of the county council, initiate and carry out the proceeding under the Ditches and Water Courses Act for the purpose of procuring proper drainage for any road or roads within the jurisdiction of such county council or commission, and such engineer or superintendent shall have authority to file notices and declarations as owner, with the clerk of the local municipality or municipalities, in accordance with the proceeding to the said Ditches and Water Courses Act."

An Advantage to the System

Now, I take it by this that the superintendent is given practically entire authority as to the drainage of the county road system, and this appeals to me as a distinct advantage to a county road system, as from previous experience I know something of the difficulties of persuading councils of the value of drainage in road construction, and as I have already pointed out, the lack of knowledge of the councils with regard to drainage laws. I do not mean this in an offensive spirit against any council, but we all understand that the present methods of election of councils does not very often permit a councillor of becoming familiar either with the law or the conditions of his municipality, before he is defeated at the polls and retires from public life, probably to the great detriment of his municipality. But let me give you an illustration of an experience that I have just had. The County of Norfolk adopted the County Road System in August, 1917, and consequently, very little has been accomplished up to the present. During January the north and south roads have been badly drifted, and we have spent considerable money in opening these roads for travel. On February 12, 13 and 14, we had a rapid thaw, accompanied by heavy rains, and on the 15th I was informed that an accident had taken place on the County Road south of the Village of Waterford, due to water being so deep on the highway. I went out with my foreman of this section to investigate. I found for a distance of about 300 feet that there was two feet of water covering the roadbed, and about eight acres of the adjoining farms under water. On enquiry of the people living in the vicinity I was informed that this happened every year, and that as a rule the water would get at least four feet deep on the roadway before the frost went out of the ground. This condition has existed for years, and the only reason that I can attribute it to is that the Township Council of this Township was ignorant of their power under the Ditches and Water Courses Act, or their absolute disregard to the value of drainage of the road, and it is instances of this kind that make me feel pleased that, as road superintendents, we have been given the privilege of carrying on the proceeding under the Ditches and Water Courses Act.

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* Norfolk County Engineer and Road Superintendent.

Up to the present time there has been no power conferred on the road superintendents under the Municipal Drainage Act. It appears to me that as the municipal drains will in most instances be the means of providing outlets for the work done under the Ditches and Water Courses Act, the superintendents should have the right to sign a petition for a municipal drain.

Difference Between the Acts

There are two particular ways in which the Municipal Drainage Act differs from the Ditches and Water Courses Act. First, in the matter of the original proceeding to procure the necessary drainage. Under the Municipal Drainage Act, the parties in an area requiring drainage present a petition to the township council, who may then proceed to have a survey report made by an Ontario Land Surveyor or civil engineer. The surveyor then reports to the township council, who have sole charge, whereas under the Ditches and Water Courses Act the municipal council has no power or contract in the matter, beyond that of an individual owner.

Secondly, in regard to the manner of carrying out the work to be done. Under the Municipal Drainage Act the parties affected are assessed a sum of money in accordance with the benefit which they receive, and this sum of money is paid over by the party assessed to the municipal council. The municipal council has charge of the work, which may be let by contract or done by day work under the direction of the council. In the Ditches and Water Courses Act, the individual owner is required to do certain work and supply certain materials to complete the work, and it is only on failure on his part to do the work or supply certain materials that it may be let by contract by the township engineer or assessed against the party defaulting.

Let us now consider under what circumstances and what way the Ditches and Water Courses Act may be used and in what manner we should proceed. There are two ways which I will mention. First, where an owner of land is proceeding to get an outlet for his water and where this directly or indirectly affects a county highway.

Secondly, where it is necessary for the road superintendent to procure an outlet that he may have proper drainage in order to construct the road.

Procedure for Drainage Provision

In the first case all the preliminary proceedings will be taken by the parties requiring the drainage, and so, therefore, the duties of the superintendent will be of a secondary nature, and I think we need only consider the case of where the superintendent commences the proceedings. I have already spoken of the municipal drains providing outlets for the Ditches and Water Courses Act's ditch, but it does not follow that these outlets will be on our roads. It may be necessary that a ditch be constructed across two or three farms in order to get to an outlet, and we will use this as an illustration. The first proceeding of the superintendent will be to find out what land he considers will be affected by the ditch, the limit of land will be those lands lying within a distance of 150 rods from the ditch or point of commencement. Having ascertained the names of the owners of these lands, the superintendent will fill out a form, provided by the municipality ,which will give the names of the owners of the lands affected, and also the concession and lot in which the lands are situated, and will designate a time and place at which all parties shall meet. At this meeting the various parties shall estimate the cost of the ditch and agree if possible upon one apportioning the work and supplying the material for construction among the several owners according to their respective interest therein, and settle the proportion in which the ditch shall be maintained. I might say here that I think the superintendent can afford to be a little generous in dealing with the owners of the land affected in the amount of work he offers to do. It means everything to the road that it be properly drained, and if it is not properly drained the increased cost of maintenance would readily affect any saving in the original draining. Therefore, I consider that we might easily offer to do what seems more than our fair proportion. If no agreement can be arrived at within five days after the original meeting the superintendent then files with the clerk of the municipality a requisition for the engineer appointed by the council, to select a time and place in the locality of the proposed ditch at which he will attend. The engineer appoints a time and the clerk will notify the superintendent, and if it is necessary serve upon the various owners a notice of the engineer's appointment. This notice must be served on the parties at least four clear days before the appointment. The superintendent will attend and meet the engineer and explain what he requires. After the engineer has made his award all parties are allowed 15 days in which to appeal to the county judge to have the award amended or set aside. If there are no appeals, the work should then be completed in accordance with the award, which will be inspected by the engineer. The award will provide for the maintenance of the drain, and the superintendent will have the right to compel the other parties to keep their ditch in a proper state of repair, and if, after thirty days' notice in writing, they fail to do so, he may call the engineer to inspect, and he will enforce the maintenance.

Advantages of the Acts

The municipal drainage affords to highway drainage the following advantages:

Under the Municipal Drainage Act we are able to secure the main outlets.

Under the Ditches and Water Courses Act, we secure:—

(1) The right to carry water across the lands of adjoining owners.

(2) The right to make use of the main outlets provided under the Municipal Drainage Act.

(3) The opportunity of having the work laid out by a competent engineer, thereby getting proper grades, etc.

(4) The right to appeal for a reconsideration of the award after a certain period, in case the drain does not do the work expected of it.

(5) The right to compel other parties to keep their portion of the ditch in a proper state of repair, and thereby always keep the outlets open and ensure that the water will not be backed up onto the road.

In conclusion I notice that a number of the road superintendents have their offices in the court house of their various counties, and I think all superintendents should have this right. You will find in the law library in the court houses, some works on drainage law, and I am sure careful study of the drainage acts read in conjunction with Proctor on Drainage, or Henderson's Ditches and Water Courses, will be of great assistance to you in carrying out the drainage of county highway systems.

Toronto Branch C. S. C. E.

The Toronto branch of the Canadian Society of Civil Engineers will hold a two days' meeting on March 26 and 27, at which papers will be presented and discussions held on various subjects. The Ottawa and Toronto branches will co-operate with this end in view. It is, in fact, to be a headquarters meeting, held in Toronto, the Council being represented by the president and members from Montreal. Invitations are to be sent to all members of the Society. It is probable that a similar meeting will be held in British Columbia during the summer.

Personals

Mr. John McCallum has been appointed road superintendent for the County of Lambton, Ont., which has recently adopted a good roads system.

Mr. Eugene McG. Quirk, a well-known Montreal engineer, has been appointed a member of the new "Canada Registration Board," which has been formed for the purpose of mobilizing the forces of the nation for the prosecution of the war.

Major H. H. Madill, of the instructional staff of the Toronto Military District, who has latterly been employed instructing the Polish recruits at the Niagara-on-the-Lake camp, has been appointed to command the Non-Commissioned Officers' Training Depot in Toronto. Major Madill was a member of the architectural firm of Craig & Madill, Toronto. The other member, Major Craig, is overseas.

At a special meeting of the Lambton County Council, at Sarnia, Ont., recently a good roads by-law was passed, providing for an extensive program of construction and improvement of county highways. Nothing but necessary improvements, however, are to be undertaken until after the war.

The Acme Engineering Company, Ltd., has been incorporated, with a capital of $25,000, head office at Toronto. The charter authorizes the company to carry on business as electrical, mechanical, chemical, metallurgical, hydraulic, and civil engineers and contractors.

Mainly Constructional

East and West—From Coast to Coast

A wind storm on the night of Feb. 25 wrecked an ore bridge belonging to the Canadian Furnace Company, at Port Colborne, the damage being about $100,000.

Messrs. D. Spencer, Ltd., propose to dyke some 200 acres of marsh land adjacent to Kanaka Creek, near Port Haney, B.C., and have had Mr. Cartwright, a Vancouver engineer, survey the property. They also plan to erect an abattoir and cattle yards.

With a view to taking on additional contracts for the construction of steel steamers, the Wallace Shipyards are contemplating considerable extensions to their plant at North Vancouver. It is understood that the contracting firm of Hodgson & King will do the greater part of the work.

It is possible that the market hall in Hamilton, Ont., which was destroyed by fire in 1917, will be rebuilt this year. A special markets committee has endorsed this action, and its recommendation is that the present walls be used and that second floor accommodation be provided and a modern refrigeration system installed in the basement. It is estimated that the cost of this project will be about $100,000.

The Bureau of Statistics and Research of Chicago has recently written to the city architect of Toronto asking what the building prospects are in that city and what difficulties are encountered in the labor market. The reply states that the prospects are excellent. Transportation difficulties are very slight, labor troubles and shortage very small, but that the procuring of structural steel was a more difficult problem.

The Dominion Shipbuilding Company has been granted a permit by the City Architect's Department of Toronto for the erection of the big shipbuilding plant which they propose to establish at the foot of Bathurst Street. The estimated cost of the plant is placed at $175,000. The foundation of the structure is already well under way, a separate permit for this having been taken out some time ago. The superstructure, for which the permit has just been issued, will be constructed of steel and hollow tile. There will be nine "bays" or sections, the whole structure being 198 x 469 feet. The site is on property owned by the Harbor Commission.

Work is being started on the vocational training building which is to be erected at Fredericton, N.B., in connection with the military hospital at the old government house. The contract for the building was awarded to Scott & Forbes. It will be 102 x 85 ft. in dimensions and two and a half storeys high. This building will be devoted to the proper training of returned men who have been incapacitated, along lines best suited to each individual case. Business courses, including bookkeeping, stenography, commercial business, are among the courses to be found on the curriculum; also mechanical and electrical engineering, automobile repair work, etc.

On Feb. 20, as a result of the break-up of the Grand River, portions of the city of Galt, Ont., were flooded and considerable damage was done. The ice, which was 3 ft. thick, badly damaged two of the bridges—those at Concession and Main Streets; broke the gas mains on both structures, and caused the water mains to spring a leak, cutting off the supply of gas and water from sections of the city for some time. The two bridges were closed to vehicular traffic and only one side on each could be used by pedestrians. South Water Street was under water and the houses along it were flooded. Fortunately the high water did not last very long.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Chatham, Ont.
City Council contemplate addition, costing $4,000, to filtration plant. Engineer, J. Adams.

Leamington, Ont.
Tenders will be called about April 1 for the construction 12 in. to 36 in. tile drains, at a cost of $11,000, for the Town Council. Engineer, J. J. Newman.

St. Brigide D'Iberville, Que.
Town Council contemplate the construction of a road from St. Angele to Farnham. Clerk, Amede Brin.

Saanich, B.C.
The construction of irrigation system is contemplated. Address, Board of Trade, Saanich, Mayor A. E. Todd, Victoria, and F. A. Pauline, M.P.P., Saanich.

CONTRACTS AWARDED

Three Rivers, Que.
Germain & Frere, 87 St. Antoine St., have the roofing contract for $12,000 pumping station and reservoir for the City Council.

Winnipeg, Man.
William Horn, Ignace, Ont., has the general contract for paving stone, costing $5,500, for the Winnipeg and St. Boniface Councils.

Railroads, Bridges and Wharves

Wallace Township, Ont.
Township Council wants estimates on both steel superstructure bridge, with concrete abutments, and on concrete arch bridge. Clerk, David Greer, Gowanstown.

CONTRACTS AWARDED

Charny, Que.
The Phoenix Bridge and Iron Works Company, Ltd., 83 Colborne St., Montreal, have the general contract for repairs, costing $7,185, to bridge for the Levis County Council, St. Romuald.

Wingham, Ont.
The Sarnia Bridge Company, Ltd., 176 North St., Sarnia, have the steel contract for bridge fo rthe Township Council.

Public Buildings, Churches and Schools

Brockville, Ont.
The following have been included in the 1918 estimates of the Department of Public Works, Provincial Government, Toronto, for the hospital for the insane: Reconstruction of bathrooms and lavatories in cottages, $600; extension of electric light system, $1,000; ventilation of main building, $1,200; implement shed, $1,000; new dairy barn and remodelling old barn, $5,000; treatment room, $5,000; fire alarm and fire protection, $1,500; improvements in heating, $2,000.

Grand Prairie, Alta.
Tenders will be called shortly for the erection of a municipal building for the Town Council. Clerk, J. H. Fitzallen.

Guelph, Ont.
St. Paul's Presbyterian congregation contemplate the erection of an addition to Sunday school. Secretary of committee, William Hamilton.

Halifax, N.S.
Tenders are being received by the secretary, R. C. Desrochers, Ottawa, until March 14 for restoration of wood roof and general repairs to drill hall for the Department of Public Works, Dominion Government.

S. M. Brookfield, Ltd., Granville St., have the general contract for temporary church for Kaye Street Methodist Church and Grove Street Presbyterian Church.

Hamilton, Ont.
The Hospital for the Insane, Department of Public Works, Provincial Government, Toronto, have included in their estimates for 1918 $10,000 for new boiler-house, $1,500 for electric wiring, transformers, switchboard, etc., $3,000 for improvements in heating, $40,000 for additional buildings, $3,000 for fire alarm and fire protection system.

Kelvin, Ont.
Tenders will be called about April 1 by John McCormick for the erection of a $10,000 church for the Methodist congregation.

The Ladysmith School Board contemplate the erection of an addition to high school. Secretary, Ira E. Lowe.

Lake Masketsy, Que.
Tenders will be called in the spring by the secretary, L. P. Lassonde, Three Rivers, for the erection of a $4,000 club house near Harvey Junction on the Transcontinental Railway.

London, Ont.
The Department of Public Works, Provincial Government, Toronto, have included in their estimates for the hospital for the insane $1,500 for improvements in heating and boiler plant, $3,500 for fire alarm and watchman's clock system, $500 for lightning arresters and electric wiring, $4,000 for fire hall, $4,000 for balconies on present building, $20,000 for new wing, hospital building to include treatment room, $6,000 for improving and addition to piggery and other farm buildings.

Makinak, Man.
Tenders will be received by the secretary-treasurer, William Coutts, Makinak, until March 12 for the erection of a brick veneer school for Makinak School District No. 979. Plans and specifications with the secretary-treasurer and the architect, J. H. Bosson, Dauphin.

Minburn, Alta.
Plans and specifications with the secretary-treasurer, P. Morrison, who will receive tenders, addressed to the Building Committee, until noon, March 15, for the erection of a church for the Minburn Union Church.

Orillia, Ont.
The estimates of the Department of Public Works, Provincial Government, Toronto, for the hospital for feeble-minded for 1918 include $36,000 for reconstruction of kitchen, laundry, and boiler-room, $10,000 for improvements in water supply for fire protection, including 100,000-gallon tank; extension and renewal of electric light system, $3,900; watchman's clock and fire alarm system, $3,500; completion of coal bunkers and building subway under G.T.R. tracks, $3,000; water purification and sewage disposal plant, $12,000; improvements and additions to farm buildings, $4,000; laundry machinery, $6,000; residence for medical director, $5,500.

Ottawa, Ont.
Tenders are being received by the architects, J. A. Pearson and J. O. Marchand, Centre Block, until noon, March 25, for switchboards, panel boards and transformers for the Parliament Building. Plans and specifications with the general contractors, P. Lyall & Sons Canstruction Co., Ltd., Parliament Bldgs.

Penetanguishene, Ont.
The 1918 estimates of the Department of Public Works, Provincial Government, Toronto, for the hospital for the insane include $2,500 for electric wiring and fixtures, $1,500 for improvements and addition to piggery and other farm buildings, $1,050 for motor for boat, $3,000 for water purification and sewage disposal plant, $6,000 for remodelling and additions to existing buildings, and $1,500 for fire alarm and fire protection system. Secretary, H. F. McNaughton, Parliament Buildings, Toronto.

Petrolea, Ont.
Plans and specifications are at the offices of the secretary, William Pratt and the architect, John M. Moore, 45 Richmond St., London, who will receive tenders until March 14 for masonry, carpentry, plastering, painting, glazing, wiring, plumbing, and hot water heating for $10,000 addition to the Charlotte Eleanor Englehart Hospital.

Pincher Creek, Alta.
Town Council contemplate erection of incinerator. Mayor, R. O. Allison.

Point Grey, B.C.
The Point Grey School Board contemplate the erection of a $25,000 school in the spring. Chairman, Donald Smith.

Quebec, Que.
The Hygienic Department, City Council, contemplate the erection of a morgue, costing about $50,000. Clerk, H. J. W. Chouinard.

Tenders will be called shortly by the clerk, H. J. B. Chouinard, for the erec-

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Roads are a Big Factor in War-Time Efficiency

THAT two successive issues of the Contract Record should be given over almost exclusively to good roads discussions is merely indicative of the large place this subject occupies in the public mind. The British Empire, and Canada as the most important unit, are fighting with their backs to the wall, for their very existence, and one of the most effective allies of our enemy is our food shortage. This condition has been brought about by the gradual, but persistent, treck of population from the country to the towns and cities, thereby reducing the sum total of our producers and increasing our consumers.

The cause of the treck is not hard to seek or at all in doubt—the country was terribly isolated and lonely. Little by little improvements in the way of telephones, mail delivery, and other so-called city conveniences have found their way into the country, but the one big essential—good transportation—lags behind.

Just as soon as our country roads permit of rapid and comfortable transportation from point to point so soon will country life begin to look good to the young men and women who are now leaving it for city "attractions" (?). As a solution of one of our national problems, therefore, the good roads movement is a foremost factor in the final outcome of the world struggle for supremacy.

Canada's Fuel and Power Resources

IN a recent paper before the Ottawa branch of the Canadian Society of Civil Engineers, Mr. John Blizzard reviewed the main sources of supply of heat and power in Canada. The most important is coal, of which some thirty million tons is needed each year. On account of the uneven distribution of Canada's coal, comparatively little being found in the central provinces of Manitoba, Ontario, and Quebec, more than half our total requirements comes from the United States. Mr. Blizzard anticipates, however, that in the course of a few years this condition may be reversed, and the United States may be forced to seek coke and coking coals from us. Of the thirty million tons, it is roughly estimated that sixteen millions are used for power purposes—railway locomotives, nine millions; industrial power, six millions; collieries, one million; a total which, at 7 pounds per h.p. hour, would be the equivalent of something over half a million continuous horse-power.

But the author goes on to point out that of the eighteen million continuous horse-power of energy in the form of water-powers at present going to waste, some eight million is estimated to be within the present range of markets. This amount, making all allowance for transformation and transmission losses, would yield, say, a million and a half horse-power for traction and industrial uses—three times the present-day requirements.

The paper also outlines our resources of wood as being very considerable; oil and natural gas as inconspicuous; and peat as existing in large quantities and probably suitable for exploitation. It concludes with a discussion of the various types of central station and a consideration of the place of each in the general scheme of conserving useful products of various sorts for commercial exploitation. Extracts from this interesting paper appear elsewhere in this issue.

C. S. C. E. Meetings in Toronto

A MEETING of the local branch of the Canadian Society of Civil Engineers was held in Toronto on Tuesday evening, March 5. Both the president of the society, Mr. H. H. Vaughan, and the general secretary, Mr. Fraser S. Keith, were present. Mr. Vaughan spoke at some length on the status of the engineer and his relation to the society and the public under the new organization. Mr. Keith also addressed the meeting on society affairs.

Plans are well advanced for an excellent program at the meeting of March 26 and 27, when Ottawa and Toronto join forces in Toronto. Ottawa has been a very active branch during the past, and it is expected that the combined enthusiasm of the two cities will produce something in the nature of an old-time convention. The complete program will be ready for announcement in our next issue.

Daylight Saving on the Way

DAYLIGHT saving appears to be an accomplished fact, if one may take as official the reported announcement of Sir George Foster a few days ago in Ottawa. The government have been strangely silent on the question, and probably Sir George's statement was in the nature of a "feeler," to see what comment would be made on it. While there have been no very enthusiastic outbursts in its favor, there is certainly no opposition, and it would appear that the electors, in general, are taking it for granted that the moving ahead of the clocks is an accomplished fact. The time only remains to be determined, and this will probably be around the first of April.

With the whole continent united in this endeavor to turn to good account an extra hour of daylight each day, it is only reasonable to expect that results will be seen in various directions, not the least of which will be the improved health and general physical condition of our citizens. Up to the present time the scheme has never been given a fair trial in Canada. During the present season it will either demonstrate its right to become a yearly fixture or it will be discarded. There seems little danger that the latter will happen.

Building Prospects in Montreal

Building prosjects for the coming season in Montreal are not very encouraging. While not wishing to be pessimistic, it may be said that no projects of any special importance are in sight, and it is probable that the chief part of the work will be residences, flats, and schools, and such work as is absolutely necessary. Houses are in very great demand, but even here the high cost of materials and labor is against extensive building. Lumber, for instance, will be considerably dearer, although in other directions there is a slight easing off in values. The building permits for last month totalled $77,045, a decrease of $325,520, while the total for the two months of 1918 is $190,155, a decline of $462,305.

Toronto Meeting Heralds New Era in C. S. C. E. Organization

Some further particulars regarding the meeting of the Canadian Society of Civil Engineers, to be held in Toronto on March 26 and 27, were given by Mr. Fraser Keith, the secretary of the society, at a meeting held in Montreal on February 28. Mr. Keith stated that under the new by-laws general meetings were to be held throughout the Dominion and in every province, if possible. In order to inaugurate the meetings, the council had decided to hold a two days' meeting in Toronto, to which every member of the society would be invited. The Ottawa and Toronto branches were co-operating in drawing up a program, and the council would be represented by a delegation. Hitherto all the society meetings had been held in Montreal, and the Toronto meeting therefore marked an important departure in the society's program. It was hoped to hold a society meeting in Saskatoon during August, and the Western branches were co-operating to this end.

The date of the Canadian and International Good Roads Congress, which is to be held at Hamilton, Ont., has now been definitely fixed as May 7 to 10.

Montreal Branch C. S. C. E. Nominations

The following are the nominations for officers and committee of the Montreal branch of the Canadian Society of Civil Engineers, the nominations being those of a nominating committee and also of ordinary members: For chairman there are three candidates—Sir Alexander Bertram and Messrs. Walter J. Francis and R. M. Hannaford; for vice-chairman, the same number—Messrs. J. A. Duchastel, Arthur Surveyor, and R. M. Wilson; secretary-treasurer, Messrs. F. B. Brown and H. M. Lamb; committee (six to be appointed), Messrs. N. B. Atkinson, John S. Bates, J. A. Burnett, J. A. Crumpton, A. Frigon, H. G Hunter, A. E. Johnson, W. D. Lawrence, O. Lefevbre, J. W. Orrock, L. G. Papineau, P. L. Pratley, F. P. Sherwood, J. A. Shaw, A. D. Swan, W. Chase Thompson, and K. B. Thornton.

The election will be by paper ballot by members residing within 25 miles of Montreal, and the result will be announced on March 14.

Toothless Metal Saws in Germany

According to the "Scientific American," quickly-revolving smooth steel disks are now being used in Germany for cutting metals, with results said to be better than those obtained with toothed saws. The actual cutting is not effected, as was formerly understood, by removing the metal, but by the heat generated by the friction between the rapidly revolving disk and the metal. That heat is so great that the metal is melted at the point of contact. The disk has consequently only to discard the molten metal and so clear the dividing groove. Naturally the steel disk also becomes heated in the operation, but as the greater part of its circumference is always out of contact, and continuously being cooled by air, its own heat remains always below the melting point. When that fact was realized, toothless saws were soon constructed which were able to cut through all metals in a minimum of time. The advantage over the toothed metal saws is that the disks do not wear out so quickly.

Opening a Montreal Office

The Canadian S.K.F. Company, Limited, Toronto, have established an office in the Board of Trade Building, Montreal, under the direction of Mr. Harold Brown, to take care of their business in that territory, and to give service to users of S.K.F. ball bearings. Mr. Brown was previously manager of the J. Stone & Company, Montreal, who handle the Stone Railway Lighting System.

Belt-Finishing Concrete Pavements

In a Western city last season concrete pavements 57 feet wide were floated successfully with a belt. The belt was 59 feet long and handled easily by two men, who went over the road at least twice after the surface was struck off. In striking off the pavement a row of stakes, 10 feet apart, was driven down the centre line to finished grade, and on these a channel iron was placed to support one end of a strike board templet for one-half the street. The centre end was operated from a bridge, which was mounted on wheels and easily pushed along.

Reinforcing of triangle mesh was placed 2 inches below the surface, and ¼-inch felt expansion joints were inserted every 60 feet.

Asphalt Concrete Construction on the Eaton Road

Paper Describing Various Consecutive Operations with Illustrations—Read Before the Recent Good Roads Conference

By R. Crawford Muir, A.M.I.C.E., A.M.C.S.C.E.*

During 1917 that part of Dundas Street in the vicinity of Toronto, between the Humber River at Lambton and the Etobicoke Creek at Summerville, 3.90 miles in length, was surfaced with asphaltic concrete. The cost was borne jointly by the Toronto and York Highways Commission and the Provincial Government of Ontario, the province paying 40 per cent. and the commission 60 per cent., under the Highway Improvement Act. On the part of the road between the Canadian Pacific Railway tracks and Etobicoke Creek, 3.32 miles long, known locally as the Eaton Road, the commission's share of 60 per cent. was borne by Sir John Eaton, who in 1909 had this section of the road built as a modern water-bound macadam road, later having a carpet coat of tar applied. Since 1913 the Toronto and York Highways Commission has been maintaining this road with an annual treatment of tar.

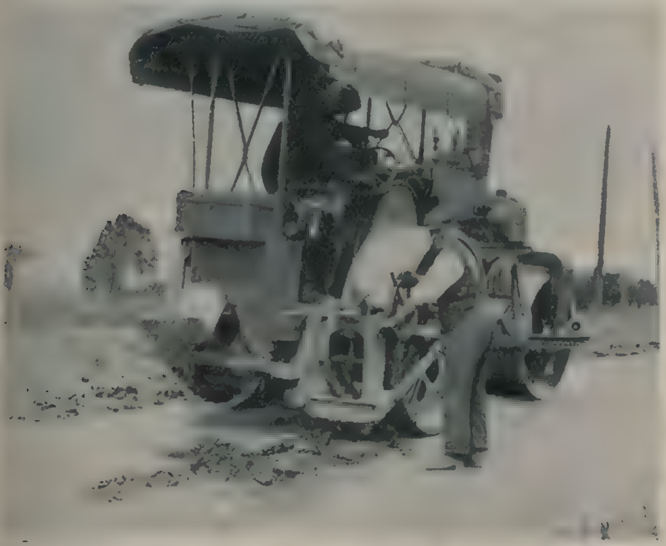
Fig. 1—Scarifier used in picking up old tar macadam.

Traffic Conditions

Dundas Street is the chief means of access to the city of Toronto from a large agricultural district. In 1909 steel-tired, horse-drawn traffic constituted approximately 90 per cent. of the traffic carried by the road. In 1917 traffic conditions had changed to such an extent that the self-propelled rubber-tired vehicles were found to be approximately 85 per cent. of the total traffic on the road. The road also carried a heavy narrow steel-tired traffic.

These changes in traffic conditions, both in volume and character, necessitated the rebuilding of this road with a more modern type of surface, and in the spring of 1917 various types of surfacings were discussed by the Toronto and York Highways Commission, and it was decided to construct an asphaltic concrete surface. The old road was pretty badly worn and in many places had an exceptionally high crown.

The new road, as constructed, is 24 feet wide, consisting of 18 feet of asphaltic concrete surface, 2 inches thick compressed, between 3 feet asphalt macadam (penetration) shoulders.

Scarifying and Preparing Foundation

The old road was scarified 4 to 6 inches deep for its full length and width, and the loose stones were drawn to the sides to form the shoulders, thus reducing the crown necessary for the new surface. New stone was added to the macadam foundation where necessary, hollows being filled and the old roadbed widened and straightened, thereby creating a better alignment. This foundation was thoroughly compressed by a 12-ton steam roller, prior to the laying of the hot mixture.

The type of scarifier used was the "Allen," attached to the side of the roller; this scarifier consisted of two picks, or teeth, and was capable of picking up 800 to 1 200 square yards a day.

Binder Coat

When the macadam foundation had been prepared, a paint binder coat of hot asphalt cement was applied to the stone surface, approximately one-half gallon per square yard, so as to permit a bond with the hot surface mixture. Surplus dust was removed, wherever possible, from the macadam foundation, in order to ensure proper penetration of the asphalt. Often it was found that the binder coat had been picked up by the wheels of the wagons, on account of too much dirt on

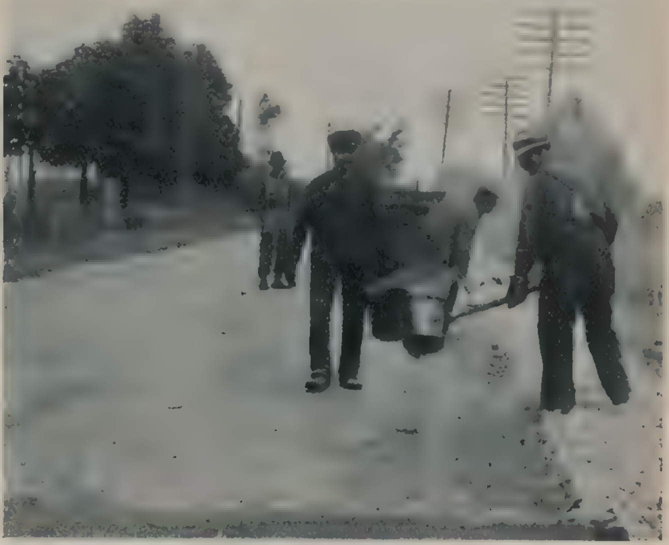
Fig. 2—Applying paint binder coat of hot asphalt cement to macadam foundation, prior to laying hot mixture.

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*Assistant Engineer, Ontario Department of Highways.

the foundation. In these cases it was more of a nuisance than a benefit. Nevertheless the binder coat is essential, and should be applied to the surface of the stone foundation as far as possible. In this instance great care was observed that the surface of the foundation along the shoulders to six feet from the shoulders was treated with hot asphalt cement, as this, in the writer's opinion, was the most important section of the surface. The binder coat was applied immediately ahead of the laying of the mixture to avoid hauling over it.

Laying the Mixture

Prior to the laying of the hot asphaltic mixture it was determined how many square yards or what number of lineal feet should be covered by a load. It was found that a load covered 29 square yards, or a length of 14½ feet. It might be stated here that a load weighed approximately 3½ tons. At the commencement of each day's work a tape was laid along the roadside and a mark made at the point where the raked material from each load should end. This occasionally varied, according to the nature and temperature of the mixture, a cold or stiff mixture covering less area. By laying out the work in this manner a check was made on the thickness of the pavement.

The hot mixture was hauled from the plant, which was located at Islington railway station, to the road, in the usual asphalt-spreading wagons, dumped on the foundation at a temperature varying from 250 to 350 degrees F., and conveyed to its final resting-place by means of shovels. In shovelling the hot mixture into place the material was shovelled from the bottom of the pile, thereby preventing the lower layer of the pile from becoming chilled. When the lower part of the pile becomes chilled an uneven distribution and compression results. On a number of the loads, especially on a long haul, the larger particles of the mixture settled to the bottom of the load. When this occurred, the mixture, on being dumped, was remixed by turning over with hot shovels. The mixture, after having been deposited roughly in place by means of shovels, was spread by means of hot iron rakes to a depth of 2¾ inches, thus allowing for an ultimate compression of two inches. During this operation the rakers did not stand on the hot mixture any more than was necessary. Care was taken that all lumps were broken and a uniform consistency and even grade maintained, so as not to have depressions in the finished pavement. Raking is a most important factor in the construction of an asphaltic concrete pavement. With a hot mixture, 300 degrees F. or more, four to six minutes were necessary for raking, but with a cold or stiff mixture ten to twenty minutes were sometimes necessary. Cold or extra stiff mixtures should be avoided, as insufficient compression and inconsistency results. As soon as the mixture was dumped on the road its temperature was taken and noted.

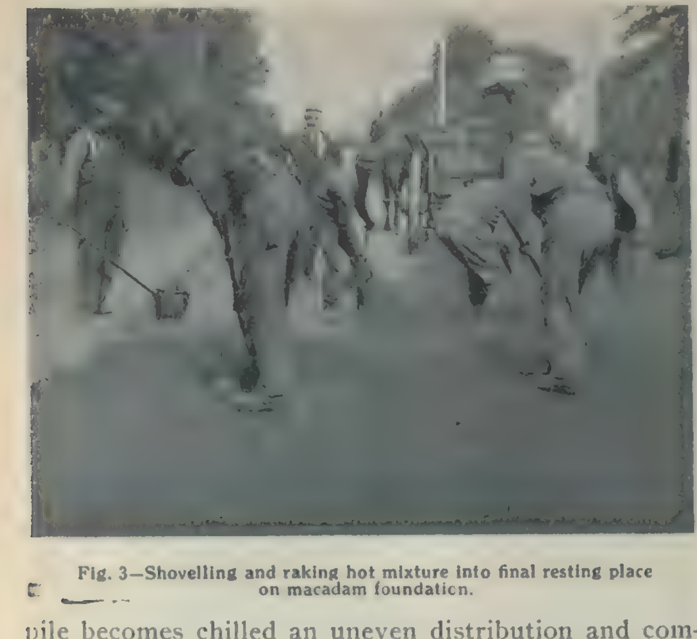

Fig. 3—Shovelling and raking hot mixture into final resting place on macadam foundation.

As soon as possible after raking—that is, without picking up the mixture or squeezing out or displacing the material laterally—the mixture was rolled with a ten-ton three-wheeled roller. Some mixtures were more tender than others, and were allowed to cool off a little before putting the roller on them. During a cold spell it was necessary to run a six-ton tandem roller over the mixture first, in order to close up the surface. and then follow this with the heavy roller. Undue delay in rolling the mixture will result in a more or less honeycombed surface. The wheels of the roller were oiled with a mixture of crude and coal oil, to avoid picking up the hot mixture. The rolling commenced at the sides, working toward the centre. This was followed by diagonal rolling, and the final finish of the work by rolling parallel to the shoulders. The rolling by the heavy roller was thorough, the roller being kept at work until the surface was too cold to be impressed.

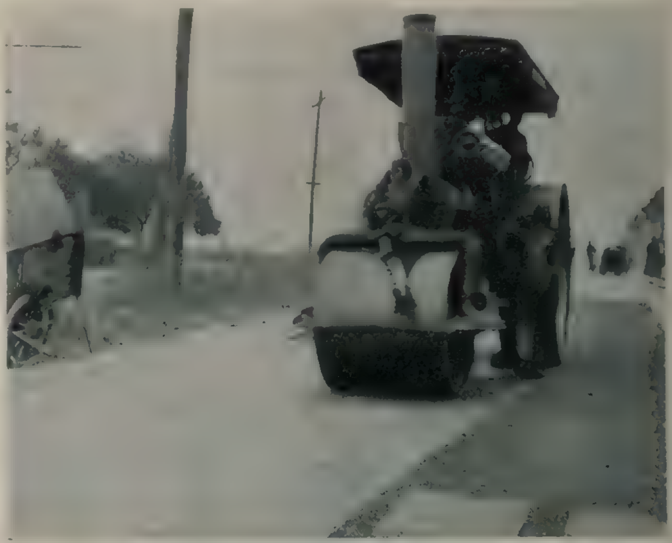

Fig. 4—Rolling hot mixture with 10-ton roller.

At the finish of the day's work it was necessary to leave the pavement in such a a condition that a proper joint might be made when the next day's work commenced. This joint was made by compressing to a feather edge with the roller and the next morning cutting back the cold mixture and thinly painting the cold surface with hot asphalt cement. On joining up after lunch hour or after any unavoidable delay, the cold surface was thinly painted with hot asphalt cement. The mixture, consisting of graded stone, sand, and limestone dust, cemented together by asphalt cement, was prepared in a Cummer portable one-car asphalt plant, hereinafter described.

Samples of the mixture were taken on the road twice a day, as soon as dumped, once in the forenoon and once in the afternoon, and a record kept of the location where the load was dumped. Care was taken in obtaining a uniform mixture. These samples were shipped to the Department of Public Highways laboratory and tested.

Loads Dumped

The largest number of loads dumped in one day was 65 (228 tons), covering an area of 1,800 square yards, or a length of 940 lineal feet. This was on the shortest haul, one-third of a mile. On the longest haul, two miles, 36 loads (126 tons), were dumped, nine teams each making four trips in six hours, covering an area of approximately 1,130 square yards. On an average, on a full day's work, 46 loads (160 tons), were deposited on the road, covering an area of approximately 1,300 square yards. These quantities would have been increased had the contractor placed more teams on the work.

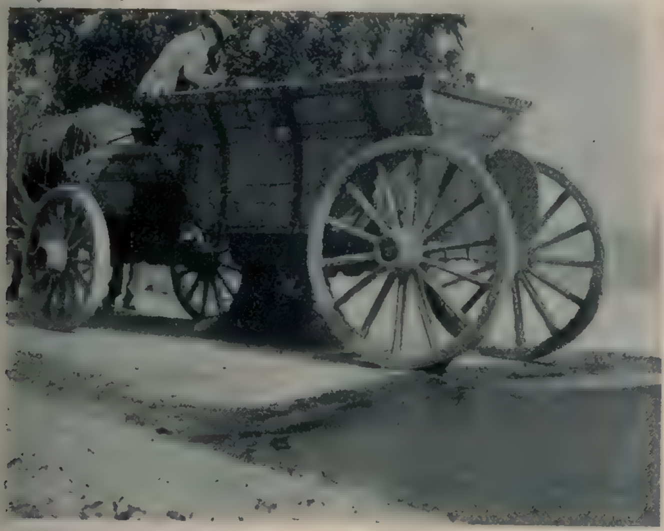

Fig. 5—Dumping the first load after lunch. The cold surface has been thinly coated with hot asphalt cement.

On the longest haul it was found that the mixture did not lose ten degrees in temperature from the time it left the plant till deposited on the road.

Seal Coat

After the mixture had been compacted, a seal, or flush, coat of hot asphalt cement was spread over the surface with the squeegee and covered with hot, coarse sand. The seal coat was applied, when convenient, immediately after the rolling of the mixture, which was still fresh and warm, but on most occasions it was applied when the mixture was cold. When the surface of the mixture got dirty, on account of the traffic being allowed to travel on it, it was necessary to sweep and thoroughly clean the surface before applying the seal coat. The asphalt cement was applied at a temperature of approximately 225 degrees F., and at the rate of one-eighth to one-quarter gallons per square yard, depending upon the condition of the surface. The purpose of this seal coat, as the name implies, is to thoroughly seal and smooth out any unevenness which may be on the surface of the coarser mixture. An excess of asphalt cement was avoided as far as possible. The asphalt cement was heated on the road in three kettles of two, three, and five barrels capacity. When the surface was damp it was found advisable to run the squeegee, containing hot asphalt cement, rapidly over the surface, to take up any moisture, before applying the seal coat.

In order to ensure a bond between the hot mixture and the stone shoulders, the hot asphalt cement was applied to the inner six inches of the shoulders during the process of squeegeeing.

Sanding on Surface

As soon as the seal coat of asphalt cement had been applied the surface was covered with coarse, hot sand, varying in temperature from 200 to 275 degrees F., and spread at the rate of approximately one cubic yard to 200 square yards. This was then rolled by a six-ton tandem roller to a true surface and left to cool before allowing the traffic on it.

The appliance, commonly called the squeegee, used in applying the seal coat, consisted of a iron box, 18 x 18 x 14 inches in size, mounted on wheels. A small hole in front of the box near the botom allowed the asphalt to flow on to the road, the flow being controlled by a lever operated by a man hauling the squeegee. On the front of the box was attached a length of belting 3½ ft. x 6 in. x 3/8 in., which distributed the cement evenly over the surface. The asphalt cement was conveyed to the squeegee by means of pails. A man with a hand squeegee usually followed the squeegee in order to spread the asphalt more evenly and to avoid matting.

Shoulders

The shoulders are composed of the stones raked from the scarified surface of the old road, to which was added new stone, in order to bring the shoulders to the proper width and depth. Material was drawn from the roadside to hold up the shoulders while rolling was in progress. During the rolling of the hot mixture by the heavy roller the shoulders were rolled sufficiently to smooth the surface and key the stones together, thereby providing a true surface before applying the asphalt.

The asphalt was applied at a temperature of approximately 225 degrees F. by means of a hand-sprinkler, at the rate of 1½ gallons per square yard. This was covered by hot, coarse sand, which was brushed into the interstices of the stone before rolling, approximately one cubic yard covering 60 square yards. The entire surface was then rolled with a six-ton tandem roller.

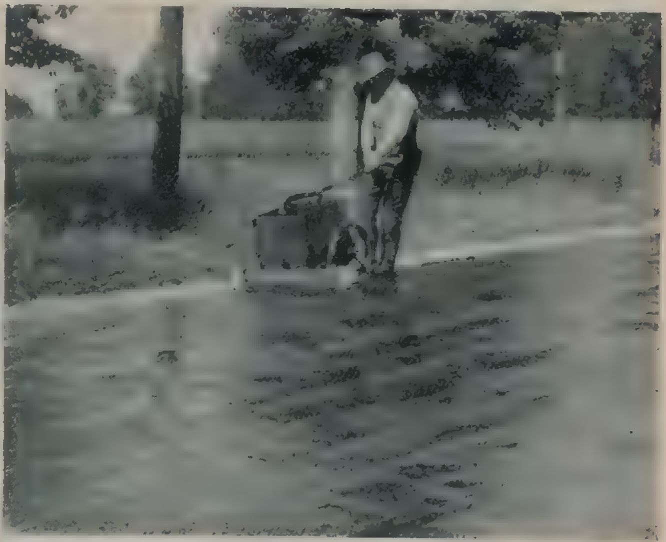

Fig. 6—Applying seal coat—approximately ¼ gallon per square yard.

The asphalt was heated in a kettle with a capacity of 12 barrels, located on the roadside. The same asphalt was used as in the mixture, but at first was found to be hard, and was later fluxed to obtain the proper consistency or penetration. This was done by adding about three-quarters of a barrel of oil to ten barrels of asphalt. This quantity was prepared late in the afternoon and was ready for use the next morning.

Paving Plant

The wearing surface mixture was prepared in a Cummer standard one-car portabe paving plant of 2,000 square yards of two-inch top per day (ten hours) rated capacity, having a twin-pug mill (10 cubic feet), capable of handling a 1,000-pound batch of material. The total weight of this plant, ready for transporting, is 100 tons.

Power is supplied by a 11-in. x 10-in. special Victor centre crank engine of 35 h.p., housed in and located near the boiler, but away from the dust. Steam is supplied to the engine by a 80 h.p. horizontal internally-fired Scotch type boiler.

The plant consists of a self-contained rotary drier, the revolving cylinder being 60 inches in diameter and 22 feet long; the cylinder revolves about 6 r.p.m., and is set at a slight incline, and has lifting angles on the inside that cascade the material over the entire area of the cylinder and gradually carry it toward the discharge end. The drier turns out approximately 25 tons of material per hour. There is a storage bin for the mineral aggregate of 15 tons capacity, fitted with a rotary screen. There are three kettles or melting tanks, each with a capacity of 15,000 pounds, arranged for air agitation. The kettles project above the casing, and are provided with tight-fitting rainproof covers. All asphalt piping and cocks are steam-jacketted. There are two elevators to the drier, one for the sand and the other for the stone; also one steel-encased elevator from the drier to the bin. The measuring box for the mineral aggregate is on a two-beam scale, so that each ingredient can be weighed separately, and the asphalt weigh-bucket is on a single beam scale running on an overhead trolley.

The power transmission consists of one main shaft, two belts, and two chains. The mixer is direct-driven from the main shaft, as is also the drier. The plant is equipped with clutches, so that the various units may be run independently.

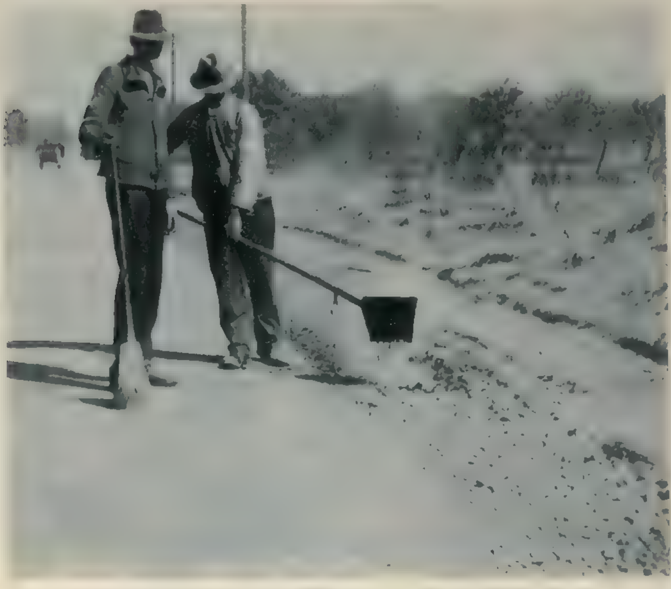

Fig. 7—Applying hot asphalt to shoulders.

Plant in Operation

The working of the plant is as follows: The mineral aggregate is fed into the drier, sand from one side and stone from the other side, by means of an open-bucket elevator. It takes ten to fifteen minutes, depending on the wetness of the material, to pass through the drier, in which time the material is dried and heated to approximately 350 degrees F., the temperature being taken from time to time at the foot of the elevator at the rear end of the drier, which carries it to the rotary screen over the divided storage bin. From the screen the mineral aggregate is delivered into the different compartments in the bin, one for sand and the other for stone. The large stones retained on the screen are conveyed by a chute to the ground. From the bin the mineral aggregate is drawn into the measuring box at the required weights. From the measuring box it is discharged into the mixer. The asphalt is elevated from the kettles by air pressure; the asphalt flows by gravity on to the air lift, then conveyed by an air compressor to the weigh-bucket, 20-pound pressure being used. From the bucket the asphalt is delivered into the mixer and thoroughly mixed with the mineral aggregate. The dust or filler is then added direct to the mixer, and the whole thoroughly dried. The time taken to mix the materials varied from 22 to 35 seconds. From the mixer the mixture is dumped into a wagon, which is directly underneath the mixer, seven batches, each approximately 985 pounds, to a load. Four to six minutes are required in loading. When the plant is working at its full capacity, three tons of coal are required per day.

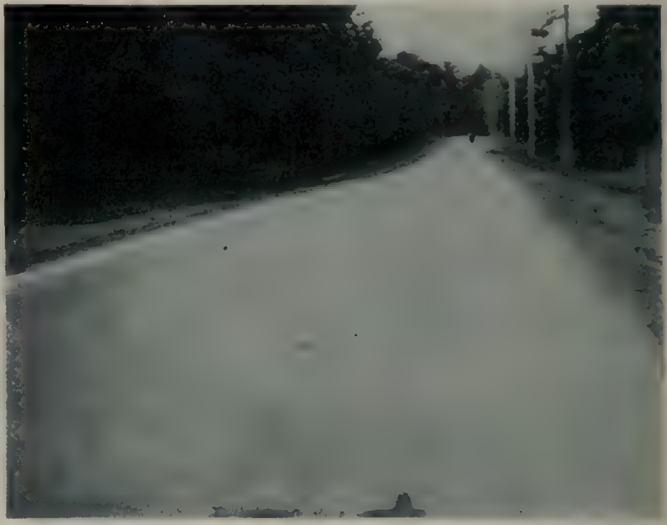

Fig. 8—Dundas Street (Eaton Road)--18-foot asphaltic concrete surface (2-in. compressed) between 3-ft. asphalt penetration shoulders.

Organization

The organization at the plant is as follows: One foreman, one engineer, one fireman, one blacksmith, two men at scales weighing materials, one man feeding stone to elevator to drier, one man feeding sand to elevator to drier, two men shovelling stone from car, two men shovelling sand from car, two men stripping barrels, etc., one man with horse conveying sand from pile to elevator, one man with horse conveying stone from car to elevator.

The sand is conveyed by a scraper from the pile near the car to the elevator, the stone being conveyed by cart from the car to the elevator.

Quantities of Materials Used Per Day

On a good day's work (eight hours) the following quantities of material were used: Sixteen tons of

(Concluded on page 212)

Ontario Good Roads Ass'n Meets in Toronto

Sixteenth Annual Convention Creates Much Enthusiasm—Important Topics Discussed and Resolutions Presented—Organization for Road Work After the War

THE sixteenth annual meeting of the Ontario Good Roads Association was held in Toronto during the three days—Feb. 27, Feb. 28, and March 1—when about 250 delegates from all parts of the province were in attendance. A number of interesting papers and addresses were presented, some of which we print, in full or in part, in the present issue. As usual, the convention was very successful in its main object—the arousing of enthusiasm and discussion regarding that most important undertaking, the provision of good roads in Ontario.

The President's Address

The president, Mr. C. R. Wheelock, O.L.S., of Orangeville, in his opening address, dwelt on the ever-increasing importance of good roads as a factor in the economic and national life of our country, and pointed out that, despite war conditions, much had been accomplished during the past year in the way of organization. He also outlined the scheme for government assistance which has been developed by the Ontario Highways Department and the classifications under which the roads of the province are placed. Extracts from his address follow:

Good roads come next to well-equipped railways for land transportation and may form a co-operative system, using the public highways—our greatest transportation asset—for the short hauls and the railways for the long distance or through traffic. What are known as "highway freight trains" have already been established in the United States on several routes. One route is from Akron, O., to Boston, Mass., a distance of about 750 miles. The equipment consists of four motor trucks, and a regular schedule is maintained.

Road construction during the past year has been greatly retarded owing to war conditions, but much has been accomplished for the ultimate success of the good roads movement. Ten additional counties have assumed county systems of roads. The Provincial Highway Act was passed and work commenced by the government on the Kingston Road. The first provincial county roads were designated in some counties and work commenced, and the Toronto and Hamilton Highway was completed and officially opened.

Bonded Debt Not Created

The highway laws of the Province of Ontario are comprehensive and workable, and provide a splendid organization to carry out the work. We have the distinction of being one of the very few provinces or states that are building up a system of main roads without creating a bonded debt.

There are now 35 counties of the 37 in Old Ontario that have adopted county roads systems, and will proceed with the work in a systematic manner, under the provisions of the highway department. Thus the result of the campaign commenced, and, carried on by this association since the year 1894, is now bearing abundant fruit.

The total mileage covered by the county roads is 8,427 and the total mileage constructed to date 2,275. As the total mileage of rural roads in Old Ontario is 55,000, the mileage covered by county roads is 15 per cent. of the total. It is estimated by the highway department that 20 per cent. of the township roads, those usually included in a county system, carry 80 per cent. of the farm traffic.

This splendid system is not a vision to be realized in the far distant future. About 2,275 miles have already been built; the organization is complete, and the work will go ahead with leaps and bounds when the war is over. This work should be of great assistance in working out the great general scheme of reconstruction that will be required after the war.

The public highways of the province are fast becoming one of the richest assets of the people. The value of a highway increases in proportion to the traffic it carries, and that the traffic is increasing is plainly shown by the increase in motor vehicles. In the year 1903 there were only 220 motor vehicles in Ontario; by the year 1910 they had increased to 4,200, and in 1917 to 84,353. The revenue from licenses last year amounted to $940,000. This increase has exceeded all expectation. The Honorable the Minister of Public Works and Highways, in his address to this association one year ago, said that the receipts for motor licenses for 1916 was $650,000, and he expected the amount to increase to $750,000 in 1917, and that by the year 1920 the million-dollar mark would be reached. The results show the expectations of the minister to have been very conservative. The million-dollar mark has already been almost reached, and I would venture the opinion that the year 1920 will bring us to the two-million-dollar mark.

Number of Licenses Doubled Since 1915

The number of licenses issued in 1917 was double the number in 1915, and the revenue of the province from this source was increased to that extent. But increased revenue means increased traffic, and increased traffic means increased expenditure on the roads, and to work this problem to a logical conclusion it would seem only fair to increase the government aid in proportion to the revenue.

In conclusion, permit me to say that this organization is carried on for purposes entirely unselfish. We feel that the prosperity of our province would be greatly retarded without an adequate system of main roads, and the officers of this association have, therefore, freely given their time and best thought to the advancement of what they consider to be the best interests of the people. The association is not connected in any way, and receives no financial support from commercial interests.

Heads of Highways Department Present

As usual, the great interest taken in the proceedings of the association by the Ontario Highways Department was evidenced by the presence of Hon. Finlay Macdiarmid, Minister of Public Works, and Mr. W. A. McLean, Deputy Minister of Highways, both of whom delivered addresses. Mr. Macdiarmid expressed his pleasure in having an opportunity of meeting and speaking to the delegates, and said his department was always willing and anxious to consider any proposals which the association might submit with regard to the general road policy of the province. He pointed out that it was the desire of the government to further the movement to as great an extent as conditions would permit, and that at the present session of the Ontario Legislature $1,000,000 had been appropriated for that purpose; however, the present was not a time for launching into very large expenditures on construction, owing both to the high rate of interest on borrowed money and scarcity of labor. With regard to the legislation covering provincial highways, he said this was passed with a view to meeting conditions which he believed would exist after the war. Last year a portion of the provincial highway east of Toronto had been taken over, but no heavy expenditures were made, only such work being carried out as would maintain the road and keep it from falling into a state of disrepair.

Curtail Road Construction Work

The Deputy Minister, Mr. McLean, dwelt on the importance of maintaining roads of every class, but opposed any large construction undertaking. The war, he said, was the all-important problem at the present time, and road work should be carried out only to the extent to which it added to our efficiency in the prosecution of the war. Construction work might be justified in some cases where local materials and labor not required for production could be employed.

Mr. D. M. McIntyre, chairman of the Ontario Railway and Municipal Board, delivered an able and interesting address on "Highways of Empire," in which he emphasized the part that road-building has played at various periods of the world's history. He characterized the Roman and British Empires as the two greatest known to history, and pointed out the important part that road-building had taken in their development.

Important Resolutions Carried

A number of important resolutions were presented at the convention and, after some discussion, the following were carried:

That provincial roads should be paid for, 70 per cent. by the province and the balance by the county, when the roads in the county system are taken over—or when county councils afterwards assume the liability—and that the county councils should have the right to adjust their expenditures in connection with provincial roads as provided in the Highway Improvement Act.

That, in the opinion of the association, it would be advisable for each county council to appoint a representative whose duty it will be to confer with similar representatives of adjoining counties, so that a complete system of connecting roads may be designated as provincial county roads and submitted to the department for confirmation at an early date.

That section 2 of the Ontario Highways Act, relating to the township road commissioner, be amended by providing for the payment of 40 per cent. of the commissioner's salary by the province, said percentage not to exceed $250 annually.

Another important resolution was passed petitioning the Dominion Government to use every effort to see that the railways provide adequate equipment suitable for transportation of roadway materials during the season of 1918, in view of the difficulties experienced in this respect last year.

Election of Officers

With the exception of two, all the 1917 officers were re-elected for the coming year, the list being as follows: Honorary presidents, J. A. Sanderson, of Oxford Station, and S. L Squire, of Waterford; president, C. R. Wheelock, Orangeville; first vice-president, J. J. Parsons, Jarvis; second vice-president, W. H. Pugsley, Richmond Hill; secretary-treasurer, George S. Henry, M.P.P., Todmorden; directors: K. W. McKay, St. Thomas; Major T. L. Kennedy, Dixie; F. A. Senecal, Plantagenet; L. E. Allen, Belleville; T. J. Mahoney, Hamilton; W. H. Brown, Chesley.

County Road Accounts

MR. WIMUND HUBER, assistant engineer of the Provincial Department of Public Highways, addressed the association on the subject of county road accounts. "The question," he said, "is how are we going to determine whether value is being received for the money spent on road work. In the case of the contractor, one reason that he can frequently do work more cheaply that a municipality is that he keeps a closer check on his work; he knows exactly the cost of the various operations." Extracts from his remarks are given below:

For some time the provincial department has emphasized the importance of keeping a set of county road accounts. This is a scheme to enable the various counties to carry on work at the lowest possible cost and the highest efficiency. One object of a system of accounting is to enable the road superintendent to ascertain the cost of each part of the work. Another is to enable him to prepare a statement from time to time ,either during the work or afterwards, and compare his costs with those on other works. A statement of cost prepared immediately after a work is very little use on that particular job, and merely helpful for future reference. A statement prepared during the progress of the work, however, shows the superintendent how his expenditures stand and how they compare with those on other jobs. He is also enabled to compare the work of the different gangs and recognize efficiency on the one hand or check incompetence on the other. A comparison can also be made between the different types of roads, and, the cost of a road being known and its length of life ascertained, it is thus determined which is the most economical.

A proper system of accounts enables the superintendent to make a satisfactory statement of expenditure on county roads to the government at the end of each year. The government has certain objects in requesting these statements: First, that of securing roads at a reasonable cost; and, secondly, they are placed in a position to compare costs of the different types of roads, etc., and distribute information as to which is the most valuable. The annual report of the department contains data of this nature.

The accounting system should show just how the money is spent on every item of the work. It is the foreman's duty to keep a time-book to show how each man was employed during each day. The county should be in a position to state how each account is applicable. In order to do so, the superintendent must classify his accounts. If this is properly done, it will enable the treasurer to post the various items in the correct manner. Thus the cost of each part of the work will be easily ascertained.

In conclusion, Mr. Huber said that the government had decidied on no standard method of accounting to be adopted by the counties in connection with their road systems, but the department was willing to give any information and assistance possible.

Provincial County Roads

By G. S. Henry, M. P. P.

ONTARIO legislation, with a well-defined purpose in each case, makes a classification of roads. This classification is primarily based on traffic, and affects the control of the roads and the amount of provincial aid appropriated for each class.

It is part of good organization in every line of industry to classify work and duties and definitely fix responsibility. This division of work and responsibility has been found essential by every country that has built up a general system of good roads. But it is necessary for each country, in dealing with this classification, to meet its own particular needs, by considering the existing units of local and central government, the means available to each in meeting responsibility allocated to it, and the equitable distribution of cost.

Classification of Roads

County roads, receiving from the province a grant of 40 per cent. for construction and 20 per cent. for maintenance, were created for the purpose of meeting the need for good market roads, radiating from local towns and shipping points. Although separated from township organization, they are, in effect, the most important of the township roads, and provincial aid to them is, broadly, aid to the townships in keeping up their most heavily travelled local roads. Local traffic concentrates on them; they require comparatively large expenditure to construct and maintain them; and good business organization indicates that this can best be done by putting them in a class and under a separate authority, the county council, which can apply uniformity of treatment to them.

Suburban roads were created in order that what is perhaps a weakness of the Ontario municipal system may be remedied—the right of cities to separate themselves from the county organization. To this class of roads cities are required to contribute, and thereby build up the standard of main roads immediately adjacent to them. To the construction of these roads the county contributes 30 per cent., the city 30 per cent., and the province 40 per cent. For maintenance the province contributes 20 per cent. and the remainder is equally divided between the city and the county.

Provincial roads were created because there is a class of highway carrying heavy traffic not merely between important cities and towns within the province, but also traffic which is interprovincial and even international. It is manifestly unfair and impossible to expect that local municipalities, or even counties, would maintain roads adapted to traffic of that character. It is, therefore, in keeping that the province itself should assume the duty of maintaining roads of this class, contributing 70 per cent. of the expenditure.

Provincial county roads are a class intermediate between county roads and provincial highways. Although not on the direct line of international traffic to any marked extent, and though not connecting the large cities, they are a class which connect the more important urban centres of the province and carry considerable traffic which originates outside of the county itself; much of it, in cases, may be traffic of a tourist character. It is intended that they will be, in a sense, co-operative with provincial roads, but under county control. To such roads the province will contribute 60 per cent. of the cost of construction and maintenance. These roads are, therefore, intended to enable the more equitable maintenance of certain county roads, carrying a considerable proportion of through traffic, but which the county may efficiently maintain, and which are not of sufficient importance to be classed as provincial, or which it is not desirable or expedient for the province to assume as provincial highways. They continue to be county roads, but because of heavy through traffic will receive an increased subsidy. In general they will form branches of the provincial highway system, joining up cities and other important terminal points of traffic. They constitute an intermediate link between the provincial and county road systems, and should be subject to special regulation.

Features Requiring Special Attention

To become entitled to the provincial subsidy of 60 per cent. for construction and maintenance the general regulations of the department should be followed, but with special regard to such features as the following:

1. The road allowance to be uniform, and not less than 66 feet in width, unless impracticable because of engineering difficulties.
2. The earth grade to be of uniform width, having a clear width of 28 feet between shoulders, safe and convenient for travel.
3. The paved or metalled surface to be double track not less than 14 feet nor more than 18 feet wide.
4. Drainage to be continuous, well defined, and adequate, with free and sufficient outlet.
5. The road foundation to be adequate, and designed according to material and sub-soil, for a 12-ton load, 9 tons on rear axles, with wheels carrying 650 pounds per inch of tire.
6. Dangerous corners and sharp turns to be eliminated, giving a clear view of at least 300 feet.
7. Excessive grades to be reduced as far as practicable, with from 4 per cent. to 6 per cent. regarded as desirable standard.
8. Steel bridges and the longer concrete bridges to have a clear width of not less than 20 feet, and to be designed for Class "C" of the departmental specifications; concrete culverts and small bridges carrying fill to be so designed as to carry a surface grade 28 feet to 30 feet wide.
9. The department to be notified well in advance of all proposed construction; plans and specifications governing all such construction to be submitted for and to be subject to the approval of the department; and all construction to follow lines and levels approved by the department or given by the department from actual survey. By this means the services of the engineering staff of the department will be of much assistance to counties in developing these roads.
10. A system of maintenance to be applied which will be prompt, continuous, and adequate, and approved by the department.

As with the general regulations, local conditions and temporary needs should be taken into consideration, so that the department should necessarily retain authority to exercise some latitude in carrying out any regulations that may be adopted.

Road Finance

MR. DANIEL QUINLAN, treasurer of Simcoe County, presented a paper on road finance, in which he put forward strong arguments for the "pay-as-you-go" system of financing road expenditures. "A common practice in borrowing money," he said, "is to spread the payment over twenty years. One objection to this is that the road constructed, no matter how well built or of what material, is generally worn out before the debt is paid, and the ratepayers are compelled to carry the double burden of paying towards the original cost of construction and also a large annual expenditure for maintenance; in other words, the roads we build are not sufficiently permanent to justify us in borrowing money for construction, and certainly not at the high rates of interest we would have to pay to-day. In fact, we cannot now borrow money for such purposes as road construction without the permission of the Minister of Finance, and, while this order is not likely to continue after the war, it is probable that high rates for interest will continue for some time.

"The objection to borrowing money for road construction does not apply with the same force to bridge construction, as bridges when constructed of concrete or of concrete and steel will last for generations; but, as the cost of bridge construction is generally only a small percentage of the total outlay, the same policy, the policy of "pay as you go," could be carried out; in other words, let the tail go with the hide."

"Pay-as-You-Go" Policy Not Burdensome

Mr. Quinlan proceeded to explain that the policy of "pay as you go" would not necessarily mean loading the people with a burden that would be difficult to carry. As an example, he pointed to Simcoe County, in which last year $50,000 was spent on county roads, and, in addition, $130,000 was paid for patriotic purposes and $50,000 to the province for war tax. All of these monies were paid out of the revenue of the year and, at the same time, the financial position of the county was improved to the extent of $30,000. "This year," Mr. Quinlan continued, "in addition to the war tax of $50,000, we purpose giving $175,000 for patriotic purposes and expending about $50,000 on our county road system, all of which we will obtain from the current year's revenue. Assuming that when the war is over the necessity for making grants to patriotic purposes will not exist and the provincial war tax is no longer levied, we would be able to reduce our annual expenditure by $225,000, and thus effect a reduction in our tax rate of 4½ mills. If, instead of reducing it by 4½ mills, we made a material increase in our expenditure on our roads, say, to $150.000, this amount could be obtained by a levy of 2½ mills and our total county rate would be 3 mills lower than it is to-day, or a total rate of 4½ instead of 7½ mills. This would not be a heavy tax rate, and would give us an amount that, judiciously expended, would in a few years give us a splendid system of roads."

Mr. Quinlan pointed out that most of our governing bodies in Canada are disposed to borrow money. Not only have the Dominion and provincial governments large debts, but most, if not all, of our urban municipalities have large bonded indebtedness, and many towns and cities find themselves in deep water owing to imprudent borrowing. "With these facts before us," he concluded, "does it not behove road builders, particularly the builders of county roads, to adopt the policy that prudence dictates and stand by the sane and sound policy of 'pay as you go'?"

Road Organization

MR. F. A. SENECAL, clerk of the Counties of Prescott and Russell, read a paper dealing with the above subject. He pointed out that the first duty of the newly-appointed superintendent is to select and instruct the men who are to keep the roads in repair. Too much care cannot be exercised in the selection of the foreman, as good or bad results in the maintenance of the road can invariably be traced to him. If the foreman be a "good roads booster"—and this he should be—sometimes a section of eight or ten miles may not be too much for him to attend to. As a rule, however, four or five miles seem sufficient.

Mr. Senecal emphasized the importance of securing the proper location of the graded roadway when laying out work, as otherwise much of the work may have to be torn up when the time comes for the placing of the stone. He also dwelt on the importance of proper drainage and the crowning of the road with the grader and maintenance with the road drag.

Snow Removal and Levelling

With regard to keeping roads open for traffic during the winter time, Mr. Senecal said: "We in the northeast part of the province have to contend with the removal of snow to a considerable extent. This winter especially the snow began to stay on the ground since the month of November last. The tools or machines usually employed are snowplows and rollers, which are used after every storm. In a few instances we have used the rollers only, with fair results. I might add that in these cases the roller had to be kept at work, even during the snowstorms; otherwise it would have been useless. I have found that the best results are obtained by using the roller immediately after the snowplow. In this case the snowplow would be required to remove only a small amount of snow. The action of the roller is to press down the sides of the road evenly, thus providing a width of 12 or 14 feet of hardened snow, which is very desirable."

In concluding the paper the following points were again emphasized: (1) In selecting the foreman endeavor to secure the best man in the locality; (2) the location being the most permanent part of the road, no heavy work should be attempted before this is properly laid out; (3) keep the crown of the road sufficiently high to allow free access for the water to the side ditches.

Mr. Vance's Paper

Mr. J. F. Vance, clerk of the County of Wentworth, also presented an interesting paper on the same subject, extracts from which are printed below:

The first principle in the organization of a county road system is the adoption of such roads as will equitably serve all portions of the county. If this principle were not adhered to, the system would be doomed to failure, as all classes of the taxpayers are proportionately charged for their construction and maintenance.

The county system having been defined, the council should place the control of the system in the hands of a small committee, with the necessary authority for the full direction of the work. It should be their duty, together with the road superintendent, to go over the system as early in the spring as possible and estimate the requirements for the season's work. The next most important item is the selecting of a road superintendent. This appointment cannot be given too much thought or consideration, since the road superintendent actually supervises all the work and is responsible for the many details of organization and the actual results to be obtained. The matter of his salary should be of little consideration, for a good man will save his salary to the county each year, while an inferior man would be dear if he were to work for nothing.

Qualifications of a Superintendent

The road superintendent's qualifications can generally be divided into three classes: First, actual construction work—in this case his knowledge of the various classes of work and ability to handle men will be shown directly in the results obtained; second, business ability—which will be displayed in the many business transactions which he is called upon to perform while carrying out the season's work; and, lastly, his cost distribution—which is of great service to the county when the annual returns are required to be made to the Department of Highways.

With a capable road superintendent appointed, the committee should be guided by his advice on all matters pertaining to road work. There should be a definite plan of construction over the whole system, and it should be carried on with a uniform standard, having in view the traffic requirements of different localities, as it will be conceded that possibly in some parts of the system the traffic will be greater than others; still, the same standard should be maintained.

The selection of foremen is one point that should be left entirely in the hands of the road superintendent, and no outside influence in this matter should be permitted. A supply of capable foremen is one of the superintendent's most difficult problems. These men can best be selected by the process of weeding out from a large number of workmen who are employed as maintenance foremen, and to those who prove themselves competent can usually be entrusted the carrying out of construction work.

Men and teams should be employed, if possible, for the entire season, as their experience and increased familiarity with the work is a considerable factor in the economy with which the work can be carried out. Sometimes it may be found to advantage when a permanent gang is employed to furnish a wayside camp; this ensures an equipment on the job at all times, and in wet weather may prove valuable in saving many a half-day's work.

Historical Discussion on Pioneer Road Building, Costs of Making and Maintaining Roads for 70 Years

By Charles Talbot, C. E.*

THIS subject covers the total mileage of improved roads in the county. They are the result of sixty-five years of county and township management. It cannot be claimed that to any particular period belongs the credit of building the highways and bringing them to their present condition.

The earliest record of township organization is found in the minutes of a meeting of the inhabitants of the Township of London, assembled at the house of Joshua Applegath on the first Monday of January, 1819. At this meeting eleven officers were appointed, and among them were three roadmasters. At the meeting the newly-appointed clerk was authorized to purchase a blank book for the records, and the tax collector was ordered to collect six pence from each assessable inhabitant to defray the expense. The book cost £1, and was paid for on January 1, 1820.

Before 1842 the Court of the Quarter Sessions had much to do with the management of the roads of the western district. On January 13, 1830, they placed on record the following resolution: "If the members of each division of roads were to furnish for their roads a proper road scraper for repairing the roads it would add greatly to the ease and comfort of the inhabitants. This might be carried into complete effect by small subscriptions of wheat delivered to persons who would get the scrapers made, and the court strongly recommends this measure to the adoption of the inhabitants generally."

Reviewing available records from 1818 to 1850, I found gravel was not used to any extent on roads. During the latter part of this period the most important road construction was done by the provincial government. The first county council of Middlesex County met January, 1850. Immediately after their organization they purchased, or were granted, control of the provincial roads within the county. Among others they assumed the Brantford, Chatham, Port Stanley, Port Sarnia, and Hagarty Roads. All were built and planked by the government, except the Port Sarnia Road, which was graded. In 1852 the county council assumed by by-law a large mileage of the more heavily travelled township roads leading to what was then the town of London. To these they from time to time added others, until, in 1860, some 200 miles of roads were under their direction.

The roads constructed by the government were built under direction of provincial engineers, in accordance with plans and specifications that provided, among other things, that all hills be reduced to a 5 per cent. grade. The road grade was, so far as possible, to be built in the central portion of road allowance, with a width of 30 to 32 feet from shoulder to shoulder. A crown from shoulder to centre of grade of ¾ inch to the foot. Open side drains were constructed with side slopes of one foot to one foot, and such width as made ample provision for effective drainage; with "tap drains" through adjacent farm lands to sufficient outlets.

The culverts and bridges were constructed of timbers. In the design of the bridge trusses iron was used for tension members where timber could not be effectively employed.

The first business of the county council was to provide means and lay plans for the gradual improvement of the county roads. This was previous to the introduction of the railroads, and the county absolutely depended upon the highways for transportation of all material to the ports of Lakes Huron and Erie. The plans adopted by the council were those under which the provincial government had worked in the matter of grades, culverts, and bridges. The plank surface was gradually replaced by a gravel surface. The last planks were removed from the Longwoods Road in 1873. The by-laws providing for the grading were entitled "By-laws for McAdamizing County Roads." The plans and specifications adopted for this provided the central portion of the grade was to be excavated to a depth of four inches and a width of twelve feet, and in the trenches thus formed screened gravel was to be placed, depositing four and one-half cubic yards to each ten feet of road. On roads of less travel the trench was made ten feet wide and three and one-half cubic yards were placed to each ten feet of road. On the whole, some 154 miles were improved before 1860. At this time the equalized assessed value of the county was $6,500,000 and their debenture debt was $875,000.

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*Road Superintendent, Middlesex County, before County Engineers and Superintendents' Conference.

Since 1860 the road improvement has been done on a more conservative basis. The necessity for immediate or rapid development of the highways was to a large extent removed by the introduction of railroads into the district in 1854, and their rapid development during the following decade. At no period, however, was the road work discontinued or seriously neglected by the municipalities in control of them.

In 1882 the county council abolished the tolled system under which they had operated their roads from the time they assumed them, and the whole county roads reverted to and remained under the control of the township council until 1907, when the county council again assumed a system of the county roads under the Act of Improvement of Highways, and they now control 400 miles.

Cost of roads is always interesting, but more especially so when their construction is the result of the labor of two or three generations. In arriving at their cost, I will divide them into three classes—1, county roads, 300 miles; 2, township gravel roads, 1,350 miles; 3, unimproved roads, 550 miles.

From 1852 to 1882 and from 1907 to 1917 the county spent on roads and bridges $1,768,000, or nearly $5,900 per mile, amounting to $147 per mile per year for the entire period they were operated by the county.

The township roads are entirely different class, and, while no accurate record of the cost has been kept, a reasonably close estimate can be made from records of taxes collected. The greater part of the grading and gravelling has been done by the statute labor system. The bridges and culverts were built under direction of the councils; they also directed a considerable portion of the road work. I find the average levy for road purposes in the different townships amounted to one and one-half mills on assessment per annum. This money, amounting to approximately $2,000,000, was spent by seventy-five councillors, elected annually by the fifteen townships. Statute labor, capitalized at $1 per day during the same period, amounts to $2,500,000, and was directed by two thousand pathmasters, annually appointed by the councils. In addition to these sums, about $140,000 was spent in 1873 and 1874, being the Sanfield Macdonald surplus granted by the provincial government to the township councils and spent by them on roads. The total cost was $4,640,000, averaging $3,450 per mile.

The roads are constructed with little attention to drainage except what was done with a view toward the improvement of the adjoining farms. The grades vary in width from 28 feet to 10 feet. The culverts are built of concrete, and the bridge of concrete and steel, and are substantially constructed. The roads were first gravelled by placing one-quarter cord of gravel on each 10 feet, and this was added to as conditions demanded. The roads thus built have a uniformity one would hardly expect under such diversified management.

An outline of how the Middlesex roads are managed by the county council might be interesting as well as instructive. As directed by the provincial highway department, they instruct their road superintendent to make an estimate of the moneys required for road expenditure for the current year. This estimate is submitted to the council, when it is ordered revised or adopted as they deem proper, and a by-law is passed setting aside the money for this work. The money is divided among the township divisions in proportion to their equalized assessed value. When the amount thus furnished is not sufficient, the additional amount required is provided by the county, and becomes a first charge on their levy for succeeding years. Interest at 5½ per cent. is charged on these overdrafts.

Townline road built in 1907. A gravel road in good condition.

For the direct management of the roads the county is divided into township divisions, and the work in each is under the direction of a committee of the council, consisting of the reeve and deputy reeves and the superintendent, with power to undertake work to the extent of the money set apart by the council for their respective divisions. This committee decides what expenditures are to be made and whether the work is to be done by day labor or contract. If by contract tenders are opened and contracts awarded by the committee. In either case the work is as the provincial regulations direct, under the supervision and direction of the road superintendent and employees of his department.

The warden of the county is ex-officio a member of the committee, and, in case of a disagreement between the reeve and deputy reeve and the road superintendent, his decision is final.

No member of the council assumes to exercise authority in the direction of the work except through their reports, which are filed with the county clerk.

This places the entire responsibility of the management on the road superintendent. The council has, by by-law, given him the power to select and employ such foremen, inspectors, mechanics and teamsters as he may require for any corporation work under his control. This, together with powers conferred by the Highway Act, leaves him entirely in charge of his department.

The whole mileage of the roads is divided into sections averaging eight miles, and each section is placed under the direction of a competent man, who is furnished a time book, time sheets, and a copy of the regulations of the Department of Highways, and is given to understand he is responsible for the maintenance of the road and that he is expected to maintain it intelligently and economically, without interference from the superintendent. Such an understanding gives him an independence of action without which a man will not render efficient service. He is responsible to the superintendent for all works entrusted to him, and is given power to employ such men and teams as he requires for his work. In effect he has complete control of his road section, except the direction of men operating the county road machinery, which is placed under separate management, under the direction of the superintendent. Each foreman returns his time and material sheets as often as he deems necessary. From the time sheets the superintendent prepares pay sheets. This pay sheet, with an order for payment, is given to the county treasurer, who forwards a cheque for the amount of the order, with the pay sheet, to the foreman. He pays the men and has them sign the pay sheet and returns it to the treasurer. Each foreman is required to furnish a bond of $500. Where work is done by contract, the foreman acts as inspector, unless another is appointed by the superintendent.

An ordinary gravel road such as the county has built and is now maintaining will accommodate a mixed traffic not exceeding 350 to 400 vehicles per day, with a moderate expenditure for maintenance. Where traffic is more condensed or heavy teaming is done extensively, gravel, if used, should be graded, and the road constructed as you would construct a stone road. In its construction and maintenance bituminous binders must be used, otherwise it will not be more serviceable than a road made of pit-run gravel.

Scheme for Flood Prevention and Power Development on the Grand River

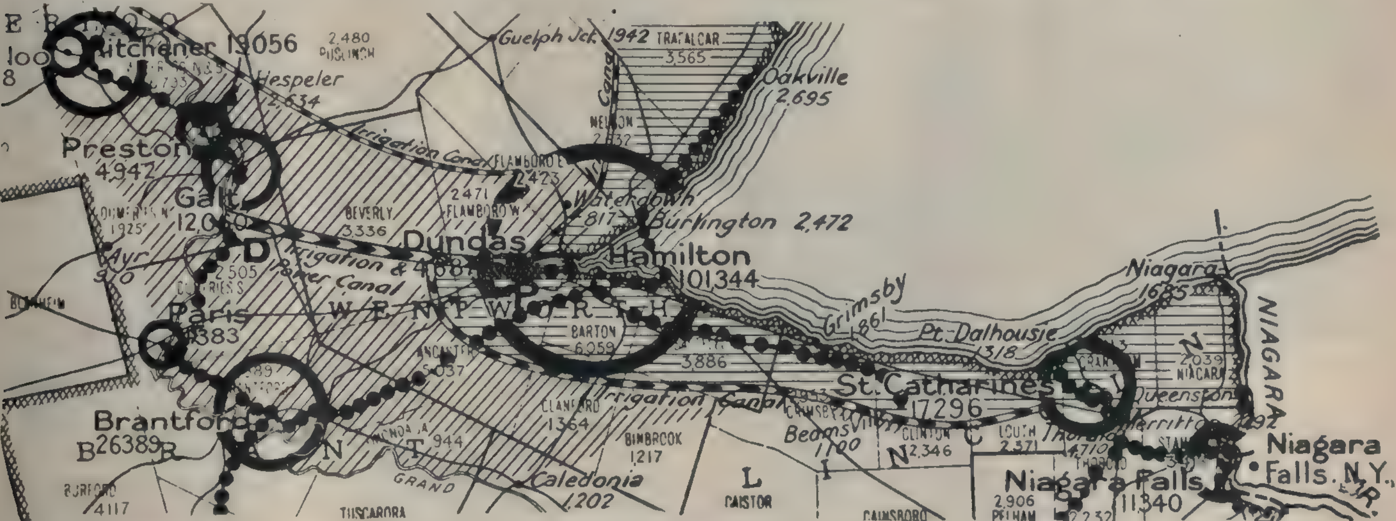
FOR some years the Grand River Improvement Association has been urging that conservation dams be built to create storage reservoirs on the upper waters of the Grand and of the Speed Rivers, in Southwestern Ontario, to absorb the spring freshets and enable their subsequent and gradual release so as to avoid scouring and damages from flood.

The cities of Brantford, Paris, Galt, Preston, Kitchener, Waterloo, Guelph, Fergus, and a number of the smaller places are vitally interested in obtaining freedom from the annual costly swirl of destruction.

Mr. W. H. Breithaupt, C.E., of Kitchener, originator of the movement, has devoted much time to the study and furtherance of this problem. Among the reservoir sites which he suggests is a large one just below Elora, some five square miles in area.

Mr. Noulan Cauchon, the consulting engineer and town planner, of Ottawa, who, with W. F. Tye, C.E., consulting engineer, of Montreal, reported on the railway situation in Hamilton, has recently urged that the Grand River conservation be carried out, not only for flood prevention, but to enable the creation of high power and also the irrigation of large areas of the most fertile land in Canada.

Mr. Cauchon proposes a main canal for joint irrigation and power purposes, from a point about three miles below Galt, at the 900-foot level, through a natural pass for some three miles easterly, thence continuing across open, level country to the 800-foot level on the escarpement above Dundas. This canal would be about 15 miles in length. At the proposed point of diversion the Grand River drains 1,360 square miles of country, with an approximate run-off of apparently between 14 and 18 inches (data incomplete). It is assumed that with the building of the Elora reservoir and one or two others within easy distance, a mini-



Flood prevention, power and irrigation in Galt-Dundas area.—Irrigable area shown hatched. Small black circles indicate railroads.

mum of 300 c.f.s. could be assigned continuously for power by regulating the flow from the reservoirs.

The drop at Dundas from elevation 800 to the Dundas marsh, elevation 245, would be 555 feet within 1¼ miles. The initial power so developed would be from 15,000 h.p. up, according and as fast as more conservation, more reservoirs, may be completed.

The existing powers below Galt, in so far as affected, would be compensated by transmission from Dundas. The Grand River would still receive its tributary waters at Paris and below; the appearance of the river would remain unimpaired by closing the dams and permitting only overflow; the domestic supply would be unimpaired.

A point in favor of this scheme is that it retains all of the conserved water over a 555-foot drop at Dundas, whereas if it be drained to run into Lake Erie, one-half immediately becomes United States perquisite, and the other half, ours, will, at best, produce only from a 300-foot fall at Niagara.

Irrigation

The irrigation side of the scheme would afford greatly increased agricultural production to all the country in the vicinity of the Grand River towns and easterly to Dundas, and around Hamilton and the Niagara Peninsula; the areas north, south, and east of the main canal being served by lesser arteries of distribution.

A branch canal would pass easterly from above Dundas to Waterdown, and, along in a northeasterly direction, to furnish water for all the hillsides of the valley below the 800-foot level, as far east as Oakville. Another branch canal would leave the main canal in the vicinity of Copetown, crossing the neck of the Dundas Valley by a viaduct or an inverted siphon, thence contouring the southern heights, passing along back of the city of Hamilton, on the highland above the escarpement, and easterly towards St. Catharines.

It is held that irrigation would enable intensive cultivation of much of the land now formed in the ordinary way, and so accomplish denser population on "small holdings." This further opens a possibility of soldier settlement, with all the amenities of civilized life, as against the hardships of pioneering on bush farms in the wilderness. It is also suggested that Hamilton could obtain a gravity water supply from reservoirs on the heights on both sides of the valley, and so dispense with pumping and its capitalized maintenance.

The scheme opens up attractive and almost unlimited possibilities of turning the Hamilon and Grand River district into a great garden city of homes and "small holdings." The Metropolitan District is recommended as a means of co-ordinated effort to this end.

Effort on behalf of the towns and municipalities affected towards obtaining government action is in the hands of the Galt Board of Trade, following a meeting of representatives there on the 7th of February.

Asphalt Concrete Construction on Eaton Road

(Concluded from page 204)

asphalt, 132 tons of stone, 47 tons of sand, 11 tons of dust or filler, making a total of 206 tons of mixture.

These weights, of course, were modified from time to time, in order to take care of the variations in the materials as delivered. Special care was exercised to see that there was always a high percentage of filler, and that the mix carried all the asphalt cement possible without being sloppy.

The materials were mixed in a batch as follows:

	Weight, lbs.	Per cent.
Stone (½ in.)	625	64.10
Sand	225	23.07
Dust (filler)	50	5.13
Asphalt cement	75	7.70
		100.00

When the quantity of asphalt cement in the mixture exceeded 7¾ per cent. of the total weight we were troubled in some places with waving and ridges in the pavement; also with more or less bleeding. On the other hand, if the percentage fell below 7, the pavement had a tendency to crack.

Fluxing Asphalt

In order to get the proper consistency as called for in the specifications, the Mexican Eagle asphalt was fluxd by adding two barrels of Fluxphalte to 45 barrels of asphalt, approximately 5 per cent. flux being used. The Imperial (Mexican) brand asphalt had the proper consistency or penetration, and therefore did not require fluxing. With the Trinidad asphalt it was necessary to add 12 barrels of flux oil to 55 barrels of asphalt to obtain the desired consistency. The Trinidad asphalt was heated to 50 degrees higher temperature than the Mexican asphalt.

On a short stretch of the road a mixture of Mexican and Trinidad asphalts, fluxed with oil, was used at the following percentages: 40, 47, and 13 respectively, with much better results than using solely the Trinidad.

The amount of asphalt used on the work was approximately 400 tons of Mexican Eagle, 50 tons of Imperial (Mexican), and 13 tons of Trinidad.

The grading of the mineral aggregate plays a most important factor in the construction of an asphaltic concrete pavement. With this in view samples of the mineral aggregate were taken and tested from time to time, often each day, in order to determine the proper grading. Samples of the asphalt and the flux were also obtained and tested. Two qualities of sand—a coarse and a fine—were obtained in the vicinity of Islington. The crushed gravel used was obtained from the contractor's pit near Erin. Crushed limestone from the Vinemount quarry was used on the first half-mile of the work, crushed gravel being used on the remainder. The limestone dust or filler was shipped in bags similar to portland cement, and was obtained from the Dundas quarry. The filler plays an important part in the mixture, since it serves to fill the small voids and to give density to the surface, thus aiding in the excluding of water and adding stability to the pavement. The amount of filler that can be used in a mixture depends upon the amount of fine sand present. The filler passes a 200-mesh screen.

Cost

The contract price was $1.10 per square yard, equivalent to $11,616 per mile, for the asphaltic concrete surface, including the scarifying of the old stone surface, and adding new stone to a depth of two inches before laying hot mixture. The price for the asphalt penetration shoulders was 60 cents per lineal foot, or 90 cents per square yard. The total cost per mile was $14,784. The work is guaranteed for a period of three years from the date of acceptance by the Toronto and York Highway Commission.

Grade Crossing Elimination Problems

Paper Before Ontario Road Superintendents' Conference—Legal and Engineering Features Discussed

By E. R. Blackwell, C.E.*

GRADE crossings of railways since the advent of automobiles, have become such a prolific source of accidents, that their elimination is a problem which must be solved. The chief difficulty to overcome is the cost, and in a great many cases this is so excessive as to be almost prohibitive.

In Canada the matter is almost altogether in the hands of the Board of Railway Commissioners, who have the power to order such changes or alterations as they may deem advisable, and to assess the cost thereof to the railway and municipality benefitted. A petition from any municipality, or from the residents of a district interested, for the protection of a grade crossing, will be considered and passed upon by the board.

A dangerous subway—very abrupt turn.

The writer had the privilege of appearing before the Commissioners on two occasions; the first was in connection with a grade crossing at Lansdowne, on the Grand Trunk Railway, and in this instance an order was made, placing a flagman on the crossing, the cost to be paid by the railway and the local municipality in the ratio of 75 and 25 per cent. A subway at this point would be very expensive on account of a steep hill paralleling the railway.

On the next occasion, an order was made for a subway on the main line of the Grand Trunk, and for about three-quarters of a mile of road diversion, which eliminates two other crossings. This is on a county road, about three miles west of the town of Brockville. The cost was assessed to the railway, subway fund, township and county in the ratio of 50, 20, 15 and 15 per cent.

Eliminate One Crossing Each Year

In the state of Vermont the railways are required to eliminate one grade crossing each year, and as the crossing is not specified, naturally the railways have built the less costly first, irrespective of the condition of the crossings and the traffic, so that now they are up against very expensive construction.

As regards the elimination of individual grade crossings, the topography of the location generally decides as to the method of separation, as for instance, if there were a grade crossing in a railway cut at the present time, and it was required to eliminate same, the natural sequence would be to carry the highway over the railway by a bridge, and by a subway if the railway was built on embankment.

As to cost, it is impossible to give any definite figure, and say that same will apply to all crossings; for instance, the unit prices of the various materials entering into construction of grade separation varies with the locality and the prevailing wages ruling in that district, also transportation for both men and materials. Therefore, each crossing is a special case by itself and should be so studied.

As regards grade separation in the cities and towns, the topographical features still control, but as a rule separation never takes place until some time after the railway has been in operation, and then the entire territory is considered as a whole and the grade line of the railway revised. In the majority of cases the grade line is generally laid so that the railway will be elevated approximately 10 feet above the ground, and the streets depressed from 8 to 10 feet, or a sufficient amount so that the excavation from the streets will make up the embankment for the railway between the streets.

A very good crossing, though a trifle narrow.

This adjustment of grade line is an economic one, from the standpoint of cost, and if the grade of ramps does not exceed three or four per cent. in 100, one can have a clear view under the railway bridge if driving a team or automobile.

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*County Engineer, Leeds and Grenville.

G. T. R. Practice in Detroit

This was the method adopted in the case of the subway built on Road No. 49 of the county system of Leeds and Grenville, in the township of Edwardsburg. The railway embankment was raised some nine feet, enabling the roadway to pass under with little or no depression. This method was also adopted by the Grand Trunk Railway in the city of Detroit, where grade separation has been going on for the last fifteen years. The Grand Trunk Railway, in making studies for grade separation in the city of Detroit, were able to prove that if the railways were carried on embankment from Brush Street Station to the top of the bench north of Gratoit Avenue, it would be much cheaper than the plan suggested by the city of depressing the railway tracks and carrying the streets over the tracks.

It has generally been found in considering the question of grade separation, that, as a rule, the economic proposition is to place the grade line of the railway on embankment, although, as I have said before, the topographical features will rule.

As regards the minimum clearance of bridges over streets and highways in grade separation in the United States and Canada, the individual States vary in their requirements. For instance, in Buffalo the minimum clearance is 13 feet, and on street car lines 14 feet; in Chicago 12 feet, with 13.5 feet on car lines; Detroit 13 feet, with 14 ft. on car lines; New York 14 feet; Philadelphia 14 feet; Vermont 13 feet, and Canada 14 feet.

The maximum grade laid for street ramps in the United States varies in the various States and cities from three to five per cent., but there have been exceptions to this in special cases, on account of location, where the grade has been 9 and even 10 per cent.

In Canada the Board of Railway Commissioners have control of grades and location.

In the Province of Ontario, where the highway passes over a railway by a bridge the clear distance between the top of rail and the lowest member of the bridge is specified in Chapter 185, Section 116, Clause 1, of the Revised Statutes of Ontario, which reads:—"Every bridge, tunnel or other erection or structure, over, through or under which any railway passes, shall be so constructed and maintained as to afford at all times an open and clear headway of at least seven feet between the top of the highest freight car used on the railway and the lowest beam, member, or portion of that part of such bridge, tunnel, erection or structure, which is directly over the space liable to be traversed by such car in passing thereunder."

Approaches to subways should be laid out so as to get as clear a view as possible and in no case should this be less than 100 feet, and if the topographical features are such that this cannot be had then a slow order by-law should be passed, and large signs, readily seen, placed on the road.

The drainage of subways is a very important matter, and when the roadway is depressed to any extent, may be very difficult and expensive, and in certain cases impossible.

When drainage cannot be had pumping has to be resorted to, in which case a well is constructed and a pumping system installed.

As an instance of expensive drainage I might mention the Thompson Road subway at Fort Erie yard, Bridgeburg. This subway is under 15 tracks and cost approximately $90,000. A deep drain had to be excavated to the nearest creek, a distance of about one-quarter of a mile, and rock was encountered, which cost about $5.00 per yard to remove.

Methods of Clay Road Maintenance

Getting the Personal Interest of the Men on the Job —The Way Roads are Maintained in Essex County

By J. P. Millen, Superintendent*

IN addressing you to-day on the Maintenance of Clay Roads, I have no doubt the subject will not be of much interest to many of you. But to us who have almost exclusively clay roads, and no better material easily available, the question is of much importance. In trying to tell you how we maintain our clay roads, I suppose it is hardly necessary to describe the condition clay roads usually get in, in the spring. After being soaked with the spring rains in a flat county such as ours, you can readily understand the ruts and holes made by the travel, as well as the many large humps of clay that fall off the wheels and dry. Now I do not propose to make any remarks as to how our clay roads used to be maintained by statute labor, or any other method, but will confine my remarks to our present methods, which, we think, are giving us good results. We have in our county system about 140 miles of road, divided into 37 divisions, with a foreman to each division. The divisions are generally about 3½ miles each, but vary from 2½ miles to 5 miles. Five miles we find to be too long, but we only have two or three cases like that. In thus dividing into divisions our object is to make them no longer than one man can properly drag in one day or less; in fact, the usual time taken is from five to nine hours, making two rounds with a split log drag.

In selecting our foreman or patrol man we try to get one who in his business going to or from the market, the mill or church, travels over the piece of road that he has to attend to, so that he has an interest in the road; for if he has not or does not take an interest in his road he is no good as a foreman for the road. We give every foreman to understand that we expect him personally to look after the road, for we have found that when a foreman sends a neighbor to drag the road it is seldom done as well, for we have taken the trouble to tell and show how we want it done, and the other man generally has some idea of his own that he tried out, to our loss.

Harrow in the Spring

In the spring, as soon as the frost is out, and if it has been freezing and thawing, oftentimes before the frost is all out, we harrow the road with a good pair of harrows; at this season of the year our experience has been that a pair of harrows will fill the ruts, the holes and level the lumps off the road better than two or three times going over with the split log drag. The harrowing also helps very much to dry the road. If the following day the road is fit to drag we drag it. Now, I know it is claimed by some that you cannot drag a road too wet, even if you drag it in the rain. This we cannot agree with from our experience. Of course, we have tried it, and we find that dragging very wet, in some places, will make it at the time nice and smooth; in other places the mud will roll, and if the road was allowed to stand until dry in that condition it would in many places be as smooth as need be. But with us, immediately after a rain it seems everyone wants to go to town or to mill, with the result that they drive all over the road that you have dragged when wet, and in half a day it is worse than when you started to drag. In support of this statement that after a rain the roads get all cut up by the traffic, I would say that we have not got a road in our system that for nine months in the year will not average more than sixty vehicles in a day, and many of the roads will average more than 200 vehicles a day. What we consider a fit time to drag is when the road has become dry enough that a split log drag, drawn at a fair angle, will clean itself.

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*Before Ontario Road Superintendents' Conference.

A typical ditch in Essex County.

Of course, we admit we would rather drag a little too wet than too dry. That is one reason why we make our divisions short for a man to look after. After our first harrowing, and possibly dragging, if we think it needs it, we then make an examination of the needs of the roads, and where necessary make drains for the better drainage. When I say better drainage of the road, I do not mean to say that our roads are not well drained, for, as far as the surface drainage is concerned, they are well drained by the municipal drains constructed in the past, many of which drains are four and five and even up to seven feet deep on one side of the road, but often on the other side of the road a small ditch, and it is these smaller ditches that often need some repairs to better drain the road, and where necessary we grade the road with a grader to make the proper crown, which in our experience needs to be not less than an inch to the foot. We have many roads crowned too high, particularly with a narrow strip in the centre of about the width of a rig, which concentrates the wheel travel in the same place all the time, and soon forms a long, continuous rut, and in wet weather the moment you get off the ridge you are going for the ditch. These roads that are too high we grade down with the grader. If the road has an even crown the wheel travel will spread over a few feet in width and the road will not so soon get ruts.

Use of the Split Log Drag

After the harrowing in the spring, we seldom use the harrow again, as we find by proper use of the split log drag that the road once formed can be kept in good smooth condition if watched. We usually make two rounds with the drag, but after a small rain in the summer one round is often all that is required. Of course, in always dragging from the outside to the middle of the road, a comber or crown may be formed. If this happens the next time it is necessary to drag the road, we drag it from the centre by driving so that the drag cuts the centre well and leaves what we cut about where the wheel tracks are.

This is the way we maintain our roads, and might shortly be summed up by saying: First, get a foreman who will take an interest in the road. In the spring harrow, then do the necessary draining and grading, and after that it is only a matter of the proper use of the drag to keep them smooth. We often say to a foreman: "Your road is a little rough," he admits it, but says it is pretty good. Pretty good is not good enough, we want it kept smooth, for if you keep the road smooth it will not get rutty, the water runs off quickly, and it is easier kept that way and does not cost as much to keep in good condition as when only occasionally dragged, for then you have to put a lot of work on it, and then you have the satisfaction of a good clay road instead of a fair one. On an average it has cost Essex County about $30 per mile for maintenance. On the Middle Road, which probably many of you know, for a distance of about 23½ miles, with seven divisions, it cost about $23 a mile in the year 1917.

We have in use two kinds of split log drags, one the usual steel kind, and the other the wooden split log, faced with steel; but in my opinion, for general use it is too heavy. The steel drag is heavy enough, and will, in my opinion, do all that is required of it.

The master plasterers of Toronto have agreed to pay the journeymen 62½ cents per hour. This agreement was settled by a committee of the masters and journeymen at the Builders Exchange on Monday, February 25th. Very good feeling has been shown throughout the negotiations. The new scale, which goes into effect on April 1st, is an advance of 2½ cents on the old rate, and is to be paid weekly, instead of fortnightly. Other concessions regarding working conditions were mutually agreed upon.

The masters were represented by Messrs. Dancy, Hoidge, Beaver, Gayton, Gander, A. Petrie and Taylor, while Messrs. Hamilton, Ward, Sims, Leach and Webber represented the men. Negotiations are still in progress with the laborers.

The Canadian Allis-Chalmers, Ltd., Toronto, have issued a folder entitled, "How Would You Design a Back-pressure Valve of Large Capacity, for Pipes, say, 20 in. Diameter and Larger?"

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Roof of Moulding Shop Raised Under Difficult Conditions

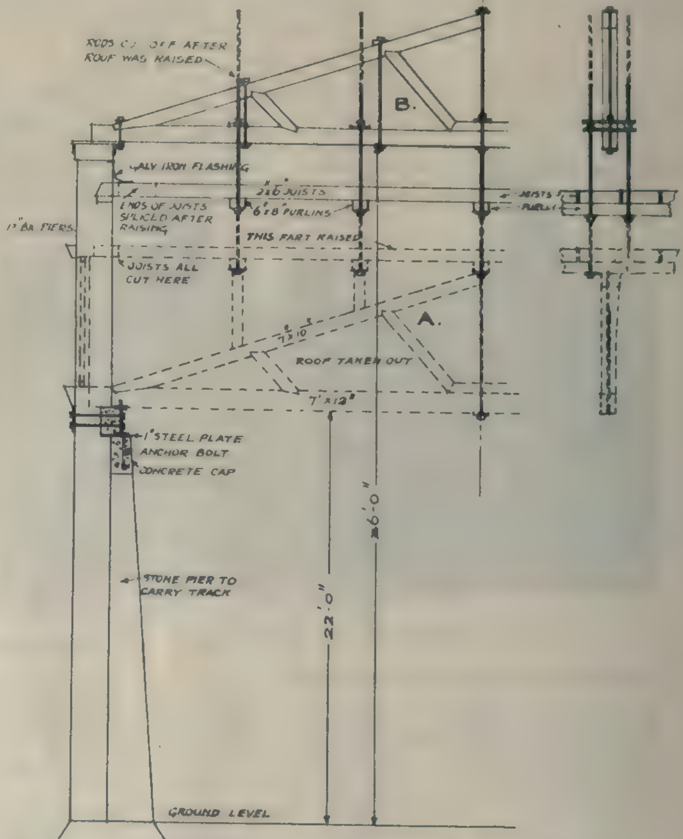
A UNIQUE piece of work, consisting of the raising of a flat roof deck a distance of 3 feet, without interfering with the operation of the plant, is described in the following article:

The William Kennedy Sons' plant, in Owen Sound, Ont., includes steel moulding shop, iron moulding shop, and machine shop, arranged in the order named. The steel shop is comparatively new and modern, having two travelling cranes. The old iron shop had an old-fashioned jib crane (wood). The construction of building is stone, walls 20 ft. high, roof carried by wooden trusses. In order to give more light and air the upper part, 10 ft. high, was constructed of wood and glass and a flat roof put on top of the trusses, which had a span of 40 ft. inside the building.

The size of old shop was 40 ft. x 60 ft., but a new addition had been added, 40 ft. x 40 ft., which was about 3 ft. higher than the old part. There was a stone wall between, 18 in. thick and 34 ft. high, which it was necessary to take down. Construction of roof of new part 18 in. I-beams, with joist. The problem which had to be worked out was to raise roof of old shop to same height as new, giving same clearance below, to admit of installing travelling crane of 10 tons capacity. In order to do this it was necessary to cut out the wood and glass part of the old shop, build piers on top of the walls to required height, place I-beams under, and jack up to height of new roof. Owing to the demand for construction steel, it was found impossible to get the I-beams in the time required. The only other alternative was to use wood. It was figured out that by building wooden trusses on top of the piers and dropping rods through them and the roof and purlins, the roof could be swung up and lifted to the required height, when the old trusses could be taken out. It was first proposed to build one new truss, place it over one of the old trusses, and take the load off it, when it could be taken out and used over the next one, and so on, until all were out, then raise the roof; but, on account of the firm being extremely busy and the old jib crane (being braced to trusses) had to be used all the time, it was decided to build all new trusses and raise the roof without interfering with the moulders, which was accomplished.

One problem which faced the contractors was the fact that the crane track had to be built further to one side of the building than the other, on account of interfering with the large sliding doors which are inside of the building on the north side, so that no piers could be built on that side to carry track, which had to be carried on iron brackets, and involved the cutting of 7 in. out of thickness of south wall above crane track. This also made it necessary to build piers on outside of building to full height to carry trusses. Piers had to be built on inside to carry crane track, which consisted of 20 in. I-beam, with steel rail.

The work was carried out by first cutting out the windows at the end of the trusses where the piers were to be built and building the piers to the under side of the roof. After erecting falsework under roof to carry joist ends, the roof was cut to permit the extension of piers and building of fire walls. Channel iron lintels of sufficient weight to carry coping walls were dowelled to the piers and walls built to the required height, chases being left in the brick work to receive the joist ends. The new trusses, B (see figure), were then erected, and suspension rods with long threads were fixed to the bottom chord of each and passed through the purlins of the roof previously carried on trusses, A. By taking a few turns on each nut, the weight of the roof was gradually taken off the lower truss and transferred to the upper one. It was then a small matter to raise the roof to the required elevation, piece out the rafters, repair the roof, and remove the old trusses.



Remodeling moulding shop.—Dotted lines indicate old roof, solid lines new construction.

Although the extensions were carried out during bad weather, Messrs. Green & Woolrich, the contractors, performed the work as per schedule.

Availability of Energy for Heat and Power

By John Blizzard, B.Sc.*

It is proposed here to outline the sources whence we in Canada receive our supplies of energy and the requirements they meet.

Coal

Coal is of first importance. In the course of a year we burn 30,000,000 tons, of which 60 per cent. comes from the United States. The remainder is mined in Canada.

Practically no coal supplies exist between the Provinces of New Brunswick and Saskatchewan, and the combined output of these two provinces amounts to only 4 per cent. of the country's production. One-half of the remaining 96 per cent. is mined in Nova Scotia and the other half is mined in the Provinces of Alberta and British Columbia. The coal reserves of Canada are enormous, and we may rely on a continuance of native supply for a very long period of years. Whether we may place equal reliance on our supply from the United States or not is uncertain. The present shortage seems to be due to abnormal difficulties of transportation rather than those of production. It is certain, however, that the supply of anthracite from that country will decrease, and that the time is not far distant when they will come to us for their supply of coke or coking coals.

A part of the annual coal consumption is accounted for as follows:

	Tons.
Manufacture of coke	2,000,000
Railway locomotives	9,000.000
Collieries	1,000,000
Bunkering ships	1,000,000

The remaining 17,000,000 tons are used for domestic and general manufacturing purposes. An approximate estimate of its subdivision is: Five million tons for domestic heating, six million for industrial heating, and six million for industrial power.

Assuming that the colliery consumption is for power purposes only, and that 7 pounds of coal generates a horse-power hour, the total mean continuous applied horse-power in Canada derived from coal is 500,000, of which locomotives develop 300,000.

Water-Power

Water-power is used for the most part to supply mechanical and electrical energy. About 2,000,000 horse-power has, so far, been developed The total available horse-power is estimated at about 18,000,000, of which 8,000,000 is estimated to be available within the present range of markets. An additional development of 6,000,000 horse-power, assuming an efficiency of conversion of 60 per cent. and a plant factor of 40 per cent. would supply about 1,500,000 horse-power continuously. This is much more than sufficient to supply that generated yearly by our 16,000,000 tons of coal.

Wood

Wood is a very important Canadian fuel. The estimated value of firewood used during 1916 was $62,000,000, or more than the value of our coal imports. Although to some extent, its use may be for power generation, principally in log-product factories, it is probable that most of it is used for domestic purposes. It is not likely that it will, to any extent, be able to take the place of other forms of energy, except spasmodically, as in times of an acute scarcity; nor is it likely that other forms of energy will take its place.

Oil and natural gas occupy an inconspicuous position compared with wood, coal, and water-power. The annual oil consumption is about 250,000,000 gallons, and practically all of it is imported. It is in a more available form for the generation of power and heat than any other fuel. While not impossible to replace it with other forms of energy for small gasoline and kerosene engines, such a change could be effected only with great inconvenience. In addition to its use for these purposes, crude oil in large quantities is used, particularly in the West, for railways, ships, and industries. Altogether, at least 100,000,000 gallons are burned under steam boilers.

Mr. Van H. Manning, director of the United States Bureau of Mines, in reviewing the oil situation of that country, estimates that its supply at the present rate of usage will last only 25 years. He further remarks that petroleum should be used neither for gas manufacture nor for fuel under boilers, nor in any way to compete with coal. It would appear, then, that we must soon find another source of supply. This may come from the known shale deposits of Canada or the United States or, possibly, from the vast unexplored areas in the west of Canada. The distillation of oil shales would not be a new venture, since, in Scotland, 3,000,000 tons are produced annually, giving about 20 gallons of oil to the ton. Another source of oil is tar obtained from the distillation of coal and lignite. Benzol, another coal-distillation product. is an excellent motor spirit, though to counteract its tendency to freeze at only fairly low temperatures it is necessary to mix it with alcohol or gasoline. Still another coal by-product, napthalene, may be used for explosion motors.

There is no doubt that alcohol is destined eventually to become prominent as a motor spirit. It is of particular importance, since it may be obtained from vegetation, and is thus independent of the stored sources of energy.

Natural gas is used in particular districts adjacent to the gas fields. Its high caloric value—nearly twice that of coal gas—renders its distribution over a large area economically possible. The annual consumption in Canada is about twenty million thousand cubic feet. It is used for industrial and domestic purposes. Since it is in a form more available for the generation of power than any solid fuel, it is advantageous to use it for this purpose whenever possible instead of coal.

Peat

Peat contributes practically nothing to our energy requirement. Yet it exists in large quantities throughout the Dominion; and, in view of its success as a fuel in other countries and the information obtained from its manufacture and use here, its availability for the generation of power and heat is known. It is impossible to believe that there is no field for its exploitation, and it must be expected soon to find a position as a source of heat and power.

This faint outline of our requirements and sources of energy does not afford information sufficient for proceeding with an enquiry which will lead to the connection of the user of power and heat with the most available form of energy. Here the possibilities of increasing the availability of our supplies of energy will be considered with reference to special methods. They will refer only to the establishment of central stations for the use of the solid fuels and to the possibility of using hydro-electric energy for house heating.

Central Station Supply

The central station may be designed to supply electrical energy, gas, steam, liquid fuel, solid fuel, and various by-products, many of which have no connection with the generation of energy. The economy of operation depends upon many factors one of the most important of which is a large system in which there is more complete utilization of the full capacity of the plant. This is due to non-coincidence of the maximum loads of the various consumers, better thermal efficiency of conversion due to the use of larger units, more complete and intelligent supervision and design, and to the possibility of operating for longer periods at the more economical rated load. The limit of the central station's sphere is reached when it is cheaper to haul the fuel to the consumer than to deliver energy through pipes or along a wire. It varies with local conditions and the type and price of the fuel. It will be greater for low-grade than high-grade raw fuel since costs of transportation vary with quantity and are independent of energy content.

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*Extracts from paper before Ottawa Branch, C.S.C.E.

The largest field for the central station will be in the generation and distribution of electrical energy. The rough estimate of the mean present power load now met by coal showed the very large requirement of locomotives. To replace the uneconomical steam locomotive with the electric locomotive seems at first sight a rational project. Where the substitution has taken place the coal consumption in the central steam electric stations is one-half of the former consumption on the locomotive. There could be no objection to its substitution for oil in forest areas and the present damage from locomotive soot and sparks would cease. An examination of the roads electrified shows that they are confined for the most part to suburban and mountain traffic. But the electrically equipped mileage is increasing, and the continuous increase in the price of coal brings the day of general electrification nearer.

The remaining power, which is used for general industrial purposes, is in itself of magnitude sufficient to warrant the consideration of central station supply. Whenever external electric supply takes the place of energy generated at the plant itself economy results. In many districts this change has resulted in reducing the coal consumption to one-quarter of its previous magnitude.

Central stations distributing gas have not so promising a field as those distributing electrical energy. The costs of transmission and the relatively high efficiency of conversion of coal into heat energy in the plant itself reduces the possible gain to the buyer. Nor is it likely that the substitution of this type of plant would save fuel. Nevertheless. the cleanliness and improved availability of gas as compared with coal would frequently lead to its preference by consumers.

Types of Central Stations

They may be of the following four types:

a. Those in which the fuel is completely gasified by partial combustion and the energy distributed either as gas or electrical power.

b. Those in which the fuel is carbonized and energy distributed in the form of solid fuel. and gas or electricity.

c. Those in which the fuel is completely burned and electrical energy and steam distributed.

d. Those in which fuel is completely burned and electrical energy only distributed.

A consideration of these stations follows:

a. The by-product recovery producer plant is the most promising means of totally converting solid fuel into gas. Its economic importance lies largely in the high returns possible by the recovery of from 60 to 70 per cent. of the nitrogen in the fuel in the form of sulphate of ammonia. It is of great value for the exploitation of low-grade fuels, particularly peat, whose nitrogen content is high compared with its calorific value. The gas produced has a heat content of about one-fourth that of coal gas. It may be distributed to consumers or partially converted into electrical energy by use of gas engines or boilers and steam turbines.

In South Staffordshire a plant has been in operation for some years, and supplies gas over an area of 123 square miles. The price paid for the gas varies from 3 to 5½ cents per thousand cubic feet. The fuel used is slack coal of a fairly low calorific value. This is the only plant which distributes producer gas on a large scale, and it is noteworthy as a possible reason for its unique position that no dividends have been paid for some years.

In Italy two by-product plants, using peat, are in operation. The energy is distributed electrically.

b. The two outstanding objects of carbonizing coal are to obtain a maximum yield of either coke suitable for metallurgical purposes or of gas suitable for domestic purposes.

The first method of carbonizing is carried out in coke ovens, wherein the long time of carbonization, large size of charge and compression give a coke of the requisite great density and hardness. It is possible with modern coke ovens to obtain a yield of gas more than sufficient for heating the charge, about 20 per cent. of the nitrogen in the coal as ammonia, in addition to light oils and tar. The surplus gas is usually of only slightly lower calorific value than town gas, and is eminently suited for distribution for general use, or may be used as a fuel at the plant for the generation of electrical energy.

The second method of carbonization differs from the first, in that smaller charges are used in order to obtain the necessary quality and quantity of gas, none of which is used for heating the retorts. As with coke ovens, coke, ammonia, benzol, and tar are recovered as by-products from retorting coal. The yield of coke, however, is less, and some of it is used for heating the retorts, while the ammonia yield is greater, due to the smaller contact with the smaller charge.

The coke obtained from retorting the gas is soft and loose in structure, and may be used in domestic furnaces. Its disadvantages for this purpose are its bulk—which necessitates more frequent firing than with coal and larger storage space—and its tendency to clinker.

The choice of installing coke ovens or gas-making retorts, both of which require much the same class of coal, obviously depends upon the possible market for the products. The development of a domestic fuel trade in the soft coke is possible if a suitable market can be found for the gas. Metallurgical coke, on the other hand, is not so suitable for domestic purposes, since it is very hard, difficult to ignite. and requires a strong draft to burn it. Nevertheless, it may prove a valuable and economical substitute for anthracite coal, if sold at a reasonable price.

c. The third type of station represents the most economical means of generating power where coal is reasonably cheap and all the exhaust steam may be used for heating. The prime mover may be either a steam engine or steam turbine of a comparatively cheap type, and no condenser is required, since the power may be looked upon as the by-product and the steam as the most valuable product. It is not possible frequently, however, to find useful employment within a small area for the exhaust steam, and heat losses prevent the transmission of thermal energy in the form of steam or hot water over a large area. On the other hand. it may prove feasible to generate power in plants where a heating load exists and transmit electrical energy to customers in the neighborhood.

d. This is the most popular type of power plant and in large sizes consists of boilers, turbo-generators, and condensers. It is too well known to need description, but it is interesting to note that steam turbines are made of 70,000 kilowatt capacity, and operate with steam pressures and temperatures as high as 350 pounds per square inch and 690 degrees F.

Warehouse Built Out of Forms

It is often convenient and advisable to re-use the falsework from one job to build warehouses and plant for a new contract. The Koss Construction Company recently took advantage of this idea in the building of a permanent warehouse by using the falsework trusses from a concrete arch bridge. The bridge arch had a span of 50 ft., and the centre trusses were set up to form two 47 ft. span barrel roofs for a 94 x 40 ft. warehouse.

Personal

Mr. R. R. Mowbray reeve of the Township of Pickering, Ont., has been appointed road superintendent for Ontario County.

Obituary

Lieut. John Rainboth, an Ottawa civil engineer who was recently invalided home from the front, where he had held a commission in the Canadian Forestry Battalion, died on March 5, following a long illness of pleurisy. He had been under medical treatment since he reached Canada, over two months ago, and there had been considerable hope of his recovery, but the news of the accidental death of his eldest son, Flight-Lieutenant Lawrence Rainboth, in Texas, in the end of last December, caused a relapse which proved fatal.

Flight-Captain Ralph H. Jarvis, M.C., whose home is in Toronto, is reported to have been accidentally killed while flying with a pupil at Spittlegate, England, on February 27. Capt. Jarvis, who was in his thirty-eighth year, went overseas in December, 1915, and, after a few months' stay in England, proceeded to France. He was mentioned six times in despatches, many enemy machines standing to his credit, and last November word was received regarding his being awarded the Military Cross. Captain Jarvis graduated from the Faculty of Applied Science and Engineering of the University of Toronto in 1911, and subsequently took a position as engineer with the Grand Trunk Pacific. Later he went to the Canadian Northern, and, prior to his enlistment, was with the Harbor Board.

The building permits issued in Welland, Ont., during the month of February are valued at $5,200, as compared with $8,200 in the same month last year. The total for the two months, January and February, is $25,610, which compares with $10,715 in the corresponding period in 1916.

A. F. Proctor, British Columbia Provincial Government engineer, announced recently that he hoped to have the Pacific and Great Eastern Railway constructed to Williams' Lake, and even 120 miles farther to Soda Creek, this year. If it is possible to push the construction to Soda Creek it will mean that water and rail transportation will be opened between Fort George and Vancouver.

Application will be made at the present session of the Ontario Legislature for a special act authorizing the Township of Crowland, Ont., without the consent of the electors, but with the approval of the Ontario Railway and Municipal Board, to construct, maintain, and operate a waterworks system. The application will request that 60 per cent. of the entire cost of construction of the trunk main be raised by a special rate levied on all the rateable property in that area, according to the last revised assessment roll, and that all branch mains and hydrants be constructed under the Local Improvements Act. The water will probably come from the city of Welland.

Mainly Constructional

East and West—From Coast to Coast

The Canadian Fairbanks-Morse Company are occupying their new and more commodious premises in the Sands Block, St. John, N.B.

The Eureka Shipbuilding Company, of Grand Manan, N.B., has five schooners of 348 tons each on the blocks at various points in Nova Scotia.

A special committee of the Works Committee in Toronto was recently appointed to consider the possibility of securing revenue from garbage. The schemes discussed are the manufacture of fuel, the raising of hogs, and a reduction plant.

A by-law is to be submitted to the ratepayers of the Township of Southwold, Ont,, on March 18, to grant to the Dominion Natural Gas Company, Ltd., the right to lay and maintain pipes for the production, transmission, distribution, and sale of gas.

The Township Council of Windham, Ont., recently awarded the contract for the steel superstructure of the McKnight bridge, near Teeterville, Ont., to the Sarnia Bridge Company. The concrete work on the abutments of this structure was begun last fall.

Vancouver's building permits for the month of February number 44, and are valued at $55,415, as compared with 36. at a value of $96,780, in the same month last year. The total for the first two months of the year is 102, valued at $108,540, as against 73, at a value of $125,825, for the corresponding period in 1916.

February building permit issues in Montreal number 41, and are valued at $77,045. This is a considerable drop from February. 1916, when there were 55 permits issued, at a value of $402,565. The totals for the first two months of this year and the corresponding period last year are respectively: 84 permits, valued at $193,155, and 88 permits, valued at $652,460.

As the damage done to the Concession Street bridge, in Galt, Ont., following the recent break-up of the ice, has rendered it unsafe for traffic and there is doubt as to whether it would be wise to carry out the extensive repairs required, the erection of a new structure is being considered. The bridge at Main Street is not nearly so badly damaged, and is now safe for heavy traffic.

The Public Works Department in British Columbia intends to carry out considerable bridge work this year. The bridges over the North Arm of the Fraser River, at Fraser Avenue, are to be reconstructed—a work which the municipalities of Richmond and South Vancouver have been strongly pressing for. When the present structure was erected the officials at Ottawa were not consulted. The plans for the new work are now before the federal engineers, and as soon as they are passed and the appropriation is through the House, operations are to start. One of the bridges from the mainland to Twigg Island will probably be commenced first, the other, from Twigg Island to Lulu Island, being constructed later. The structure recently swept away by the Vedder River floods is also to be replaced. New bridges will be installed in the Bella Coola districts where great damage was also done some months ago by floods, and another will be provided at Vermilion, in the Lillooet district. The government proposes to replace ferries by bridges where possible, to eliminate the heavy annual expense for operation. This course will be followed on the North Thompson, for instance.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Chicoutimi Parish, Que.
Tenders will be called shortly by the secretary-treasurer, Diego Villeneuve, for $15,000 waterworks system for the municipal council.

Chinook, Alta.
Town council contemplate the construction of new water supply system in the spring.

Delta, B.C.
Town council contemplate improvements, costing $25,000, to roads. Clerk, N. A. McDiarmid.

Grand'Mere. Que.
Town Council contemplate alterations to aqueduct system. Engineer, Charles Gelinas.

Hamilton, Ont.
The Department of Public Works, Provincial Government, Toronto, have included in their 1918 estimates the sum of $15,000 for reservoir at the hospital for the insane. Secretary, H. F. McNaughton, Parliament Buildings, Toronto.

Lardner, B.C.
Town council contemplate drainage system, costing $20,000. Reeve, A. D. Paterson.

St. Benoit, Que.
Specifications are with the secretary-treasurer. V. Dejardins, who will receive tenders until noon, March 30, for gravelling roads for the village council.

Toronto, Ont.
The Department of Public Works, Provincial Government, have included the sum of $21,000 in their 1918 supplementary estimates for drainage work throughout the province. Secretary, H. F. McNaughton, Parliament Buildings, Toronto.

The sum of $219,198 has been included in the estimates of the Department of Public Works. Provincial Government, for year ending October 1918, for colonization roads. Secretary, H. F. McNaughton, Parliament Buildings. Toronto.

CONTRACTS AWARDED

Ottawa, Ont.
The National Iron Works, Ltd., foot of Cherry Street, Toronto, have the contract for pipe in connection with the construction of a water main, costing $9,600, at Booth and Montreal Street, for the city council.

The National Iron Works, Ltd., foot of Cherry Street. Toronto, have the contract for pipe in connection with repaving Slater St., from Bank to Bay, at a cost of $9,000, for the city council.

Railroads, Bridges and Wharves

Burford Township, Ont.
Tenders received by the clerk, F. W. Taylor, Burford P.O., until April 1, for the erection of a 16-ft. beam span reinforced concrete bridge for the township council. Engineers, Jackson & Lee, Temple Building, Brantford.

Grand'Mere, Que.
The business men of Grand'Mere and Shawinigan Falls have formed a company and contemplate the construction of an electrical railroad, costing approximately $100,000, from here to Shawinigan Falls.

Ottawa, Ont.
Tenders are being received by the secretary of the Department of Railways and Canals, J. W. Pugsley, until noon, March 26, for the erection of 51 section-houses on the line of the National Transcontinental Railway for the Canadian Government Railways.

Toronto. Ont.
The provincial treasurer has placed in his estimates for 1918 the sum of $686,711 for railway work for the Temiskaming and Northern Ontario Railway Commission, secretary-treasurer, W. H. Manud,, head office, 56 Church St., for buildings, line extensions, and various other improvements; also purchase of equipment and material.

Vancouver, B.C.
The Department of Public Works, Dominion Government, contemplate the erection of a $30,000 bridge on the Marine Drive. Address, Reeve V. V. Vinson, West Vancouver.

Vaughan Township, Ont.
The Vaughan Township will rebuild bridge over Humber River which was destroyed by flood. Engineer, Frank Barber, 40 Jarvis St., Toronto.

CONTRACTS AWARDED

Brantford Township, Ont.
George Thompson, 223 West Mill St., Brantford, has the general contract for two $2,000 bridges for the township council.

Trois Pistoles, Que.
A. H. Morin has the general contract for the erection of a steel bridge on concrete foundations over the River Matane. The Phoenix Bridge Company have the contract for steel work. The lump price of contract is $29,600.

Public Buildings, Churches and Schools

Brantford Ont.
The General Hospital contemplate the erection of an extension to nurses' home.

Cape Breton County, N.S.
Alterations to jail are contemplated by the Department of Public Works, Provincial Government. Secretary-treasurer, F. F. Mathers, Province Building.

Chicoutimi, Que.
Plans and specifications with the architect, Alfred Lamontagne, who will call tenders shortly for the erection of a $50,000 church for the Endiste Fathers, Chicoutimi West.

Colchester County, N.S.
The Department of Public Works, Provincial Government, contemplate alterations to jail. Secretary-treasurer, F. F. Mathers, Province Building.

Del Bonita, Alta.
Plans and specifications are with the secretary-treasurer, W. L. Baxter, Del Bonita, who is receiving tenders for the erection of a school for Shanks Lake School District.

Fort Qu'Appelle, Sask.
Tenders will be called about March 15 for the erection of a $250,000 tuberculosis sanitorium for the Saskatchewan Anti-Tuberculosis League, Regina. Architects, Storey & Van Egmond, 1013 McCallum Hill Building. Regina.

Grand'Mere, Que.
Edmond Guimond is negotiating with the city council with a view to erecting a hospital.

Griffin Creek, Alta.
Plans and specifications are with the secretary-treasurer, Cecil McKenzie, who is receiving tenders until noon, March 20. for the erection of a school for the Grey Eagle School District, No. 3526.

Halifax N.S.
Harris & Horton, Keith Building, are preparing plans for alterations and repairs, costing $18,000, to the Institute for the Deaf and Dumb, Gottingen St. President, Rev. Dr. Forrest, 22 Tobin St.

Hamilton, Ont.
The city council have decided to rebuild market hall which was recently destroyed by fire. Clerk, S. H. Kent.

Lethbridge, Alta.
The city council contemplate the erection of a $30,000 "Carnegie" library. Mayor, W. D. L. Hardie.

London. Ont.
The Department of Militia and Defence. Dominion Government, contemplate the erection of a $10,000 military building. Address, Major Bishop, Wellesley Barracks, London.

Merton, Alta.
Municipality of Merton contemplate the erection of a municipal hospital. Reeve, A. Carson, Oxville.

Mount Dennis, Ont.
Tenders are being received by the secretary-treasurer, S. McCormick. Silverthorn Ave., until March 27. for $35,000 addition to school for School Section No. 28, York. Architects, Ellis & Ellis, Manning Chambers, Toronto.

Nelson, B.C.
The town and provincial government contemplate the erection of a provincial normal school. Clerk, W. E. Wasson.

Orillia, Ont.
The supplementary estimates of the

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Concrete in Alkaline Regions

TO what extent the presence of alkali affects concrete has been the subject of considerable discussion and research among engineers for several years. It is believed by some engineers that many failures due to the use of a poorly-proportioned aggregate and too lean a mixture have been wrongly attributed to the effect of alkali. On the other hand, laboratory investigations have shown that complete failures of the very best specimens may be obtained by using alkali concentrates and accelerating the chemical reactions. There is no doubt that in some cases this latter condition is duplicated in the field, where a porous concrete acting as a filter would cause a rich deposit of the salts in the voids of the finer aggregate, thus creating identical conditions to those of the laboratory tests. Further, it has been determined that the formation of carbonates of sodium, calcium, and magnesium are the results of the chemical reactions of the alkali on cement. In the case of piers and wharves exposed to sea water, a coating of sodium carbonate is sometimes found deposited on the outside. This carbonate is impervious to the action of the alkali, and so may prevent a deterioration that would otherwise take place. It appears to follow, then, that the proper course to pursue in placing concrete under alkali conditions is to ensure a dense mix by carefully grading the aggregate and by making it reasonably strong, thus cutting down the capillary action of the pores of the concrete.

The Bureau of Standards of the United States are performing some extensive experiments by exposing cement mixtures of varying known composition and fabrication to reaction in the field. The work of the bureau is not complete, and, indeed, they have not reached that stage in their experiments where they can form any definite conclusion. A paper by Mr. Greene, Winnipeg, reproduced elsewhere in this issue, also deals with the experiences of a large contracting company in Central Canada. All evidence points in the same direction—where the presence of alkali is suspected use special care in the preparation of the concrete. In the meantime, the national importance of the subject would justify any reasonable expense in pursuing experimentation further.

Chemical Possibilities of Fuel By-Products

FOLLOWING the reading of Mr. John Blizard's paper, "Availability of Energy for Heat and Power," before the Ottawa branch of the Canadian Society of Civil Engineers recently, the discussion was introduced by Mr. Edgar Stansfield, M.Sc., chief engineering chemist, Mines Branch, Department of Mines, Ottawa. Mr. Blizard's paper was reproduced in extract in last week's Contract Record. Mr. Stansfield's remarks follow:

There are two points to which I desire to call attention. The first is that Mr. Blizard has made it evident that the question of how best to utilize our sources of energy involves both engineering and chemical problems. There was a tendency to relegate the chemist to the attic, as it were, and to submit to him only spefic questions. This is, fortunately, now passing or passed. We must realize that only by full co-operation between engineer and chemist can we make satisfactory progress towards our goal.

A full treatment of the fuel problem cannot neglect the chemical possibilities of fuels. It is needless to enumerate the chemical compounds, dyes, fertilizers, antiseptics, etc., obtained from coal; their great number and their importance are too well known. They are all derived, as was stated in the paper, from the primary products of the carbonization or coking of coal. The coking of coal and the exploitation of its by-products constitutes a very large industry, notably in Germany, but also in England and elsewhere. The paper points out some of the limitations of this method of utilizing fuels; in Canada our difficulties in this respect, as in others, are greatly increased by the distances between centres of population and the geographic distribution of our fuels. Nevertheless, I am more optimistic than Mr. Blizard as to the future of the carbonization industry. It does not appear to me impossible that even in Ottawa we may have in the not very distant future a large coke oven plant, which will operate on water-borne soft coal from Nova Scotia, coking it in ovens rather than in retorts, on account of the economies of the larger scale process, and which will distribute gas and coke for domestic and factory use throughout the cities of Ottawa and Hull.

Mr. Blizard referred to oven coke as "metallurgical coke," and described it as too hard for convenient domestic use; such coke is made by what is called high temperature carbonization. Low temperature carbonization gives a softer coke, and has many apparent advantages. Its commercial development with respect to bituminous coal so far, however, has been very disappointing, although I still hope for a future for the method.

Carbonization is not confined to bituminous coal. The commercial development of low-grade lignite will probably involve low-temperature carbonization. Some of us have been engaged for the past year in studying in the laboratory the possibilities of this process, and, as has been stated in the daily press, there is a project under consideration for the establishment of a commercial carbonizing and briquetting plant in the West. I am of the opinion, moreover, that the carbonization of peat may prove a commercial possibility. The carbonization of wood to form charcoal, wood alcohol, acetic acid, etc., is already a well-established industry. In every case carbonization gives solid, liquid, and gaseous products with great economic possibilities. The solid products of the lower grade fuels—lignite, peat, and wood—have comparatively high calorific value, and can, therefore, stand transportation charges to far greater distances than can the original fuel.

The second point to which I desire to call attention is the way in which private individuals and corporations wastefully exploit our resources of fuel for their own immediate gain.

Coal is wasted in many ways in the winning, and Mr. Dick has stated that the percentage of available coal brought to the surface from our mines is often very low. Thus where a thick and a thin seam occur together, quick profits can be made by working the thick seam only, but the thin seam is lost to us, probably for ever. Is this right?

Under present conditions, in some districts remote from centres of population, immediate profits might be made by extracting gasoline from natural gas and allowing the gas to go to waste for lack of a convenient market. Can this be permitted?

Fuels are wasted in utilization, as Mr. Blizard has shown. Our railways burn nine million tons of coal a year, with an efficiency of only 3 per cent. Out-of-date and inefficient power plants are wasting our fuel resources, and the wasteful use, as well as the wrongful use, of power on all sides add to this orgy of extravagance. These methods may give immediate dividends to individuals, but we must consider the present and the future welfare of the whole country. Can we afford to let these methods continue?

Again and again arise the questions: Is it right, wastefully, to exploit our resources for immediate gain? Can we afford to allow this waste to continue?

Mr. Blizard's paper not only calls attention to these points, but is also suggestive as to methods of remedy. May I recommend the following for consideration:

Fuel Recommendations

That a Dominion board of energy commissioners be established, somewhat on the lines of the Board of Railway Commissioners, and that this board be given wide powers.

That the board consist of mechanical engineers, electrical engineers, and chemists, the best men available in their respective spheres, having not only high scientific and technical ability but imagination.

That the board be given investigative, advisory, and restrictive powers:

Investigative power to carry out such laboratory and large scale investigations as are necessary for the efficient utilization of our resources; the scope of the investigations to include the winning and marketing of fuels and their by-products, as well as the development and employment of power and heat.

Advisory power to furnish the best advice and most up-to-date information, including recommendations as to new developments, improvements of old plants, consolidation of power plants, and the co-operative establishment of allied industries.

Restrictive power to prohibit the inception of needlessly wasteful schemes, and to compel the improvement within a term of years, where such improvement can be shown to be commercially practicable, of all established, needlessly wasteful, processes.

Joint Committee of Technical Organizations Meets March 25

It is announced that the annual meeting of the Joint Committee of Technical Organizations (Ontario branch) will be held on Monday evening, March 25. At this meeting the president's report on the year's activities of the committee will be presented. Prominent speakers have also been secured in the persons of Col. David Carnegie, member and ordnance adviser, Imperial Munitions Board; J. M. Butler, managing director, Armstrong Whitworth of Canada, Ltd.; and W. E. Segsworth, administrator, vocational branch, Military Hospitals Commission. The meeting will be held in the Chemistry and Mining Building of the University of Toronto.

Nova Scotia Society of Engineers Joins with the C.S.C.E.

Mr. Fraser S. Keith, Secretary of the Canadian Society of Civil Engineers, was in Halifax recently in connection with Society affairs, and met as many of the local members as could conveniently get together on short notice at an informal supper, Friday evening, March 8th. Mr. Keith was able to announce that as a result of a meeting that afternoon between himself as representing the Council of the Canadian Society and a committee of the Nova Scotia Society of Engineers, a resolution was adopted, subject to the approval of both sections, with a view to affecting an amalgamation of the Nova Scotia Society with the Canadian Society of Civil Engineers. Mr. Keith at the same time discussed with local members present the affairs of the Canadian Society in general with special reference to recent changes in the by-laws and the change in name. There was a free and enthusiastic discussion and it was unanimously decided to make application to the Council of the Canadian Society for the formation of a branch in Halifax.

Application has also been made to the Council of the Canadian Society for the formation of a branch in St. John, N.B.

The lightest section arch-dam in the world is the Medlow dam, on Adams Creek, in the Blue Mountains of New South Wales. The structure is of concrete and is 65 feet high from the foundation to the top of the parapet. The up-stream face is vertical. The wall is 8.96 feet thick at the base, tapering on the down-stream face to 3.5 feet thick at a height of 29 feet, keeping that width to the top water level and finishing with a parapet wall 1 foot thick for the remaining 3 feet of height.

The Duncan Street Hydro Sub-Station

Concreting Performed in Zero Weather — Methods of Heating — Interesting Footing and Truss Designs

THE extension to the existing substation at Duncan Street, Toronto, for the Hydro-Electric Commission, will very shortly be ready for the installation of the distributing plant. A brief description of the construction work is timely, therefore. The excavation for the plant was commenced during the summer of 1916, and the first concrete was poured in November of the same year.

During the excavating considerable underpinning was necessary to support an adjacent building. Wood sills were blocked under the walls, and after the steam shovel had cut channels under the building, posts were placed under the sills and carried down to the bottom of the excavation. Anticipating severe weather, the contractors housed their mixing plant in the basement, building the hoisting tower outside, on the south side of the building, and using Ransome spouts to convey the concrete to the forms. A study of the cuts shown will indicate the heavy construction used throughout the building, and will readily account for the 1,700 cubic yards of concrete and 185 tons of steel.

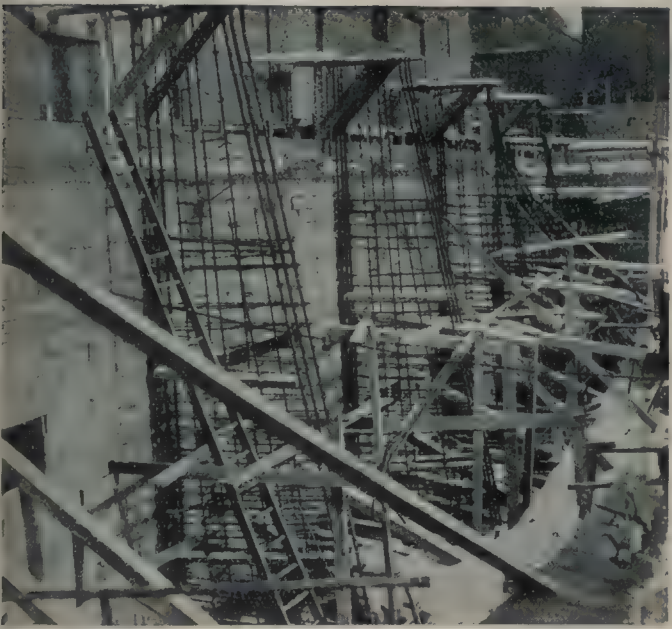


Fig. 1—Showing reinforcing to pilasters, north elevation.

The roof beams and slabs were poured during the severe cold this past winter. The method employed for heating the concrete mix was as follows: Sections of smoke-stack were laid on the ground and wood fires maintained in them. The stone and sand were heaped over these pipes and were not used until they were thoroughly warmed. Boiling water was secured by turning a steam jet from the boiler into a barrel of water. Special precautions for keeping the concrete from freezing after it was placed were taken. All the openings to the fourth floor were blocked with canvas and several coke salamanders distributed over the floor. As soon as a small section of the roof was completed, a layer of building paper was stretched over the surface and covered with plank. The whole was then covered with a good coating of shavings and straw.

Reinforced Concrete Design

The reinforced concrete was designed by L. G. Mouchel & Partners who are the exponents of the Hennebique system of steel reinforcing in this country. In this system ordinary shapes of reinforcing iron—i.e., squares, flats, rounds, in fact, any commercial section giving the required section area—are used and can be purchased in the open market from any of the mills rolling the smaller sizes of steel. In the accompanying cross-section the solid black portions indicate sections of the concrete, which continue through the building

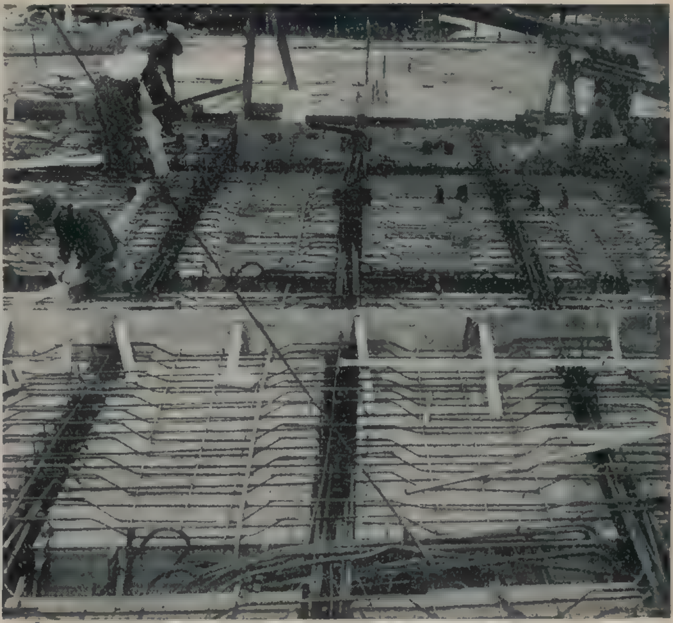


Fig. 2—Forming and reinforcing for ground floor slab.

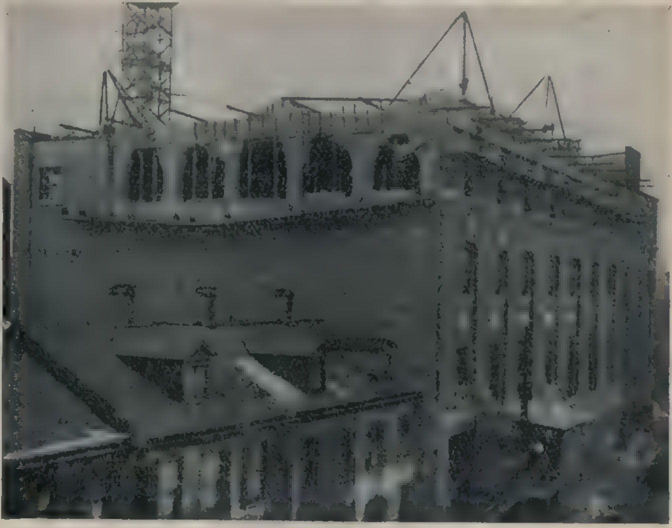
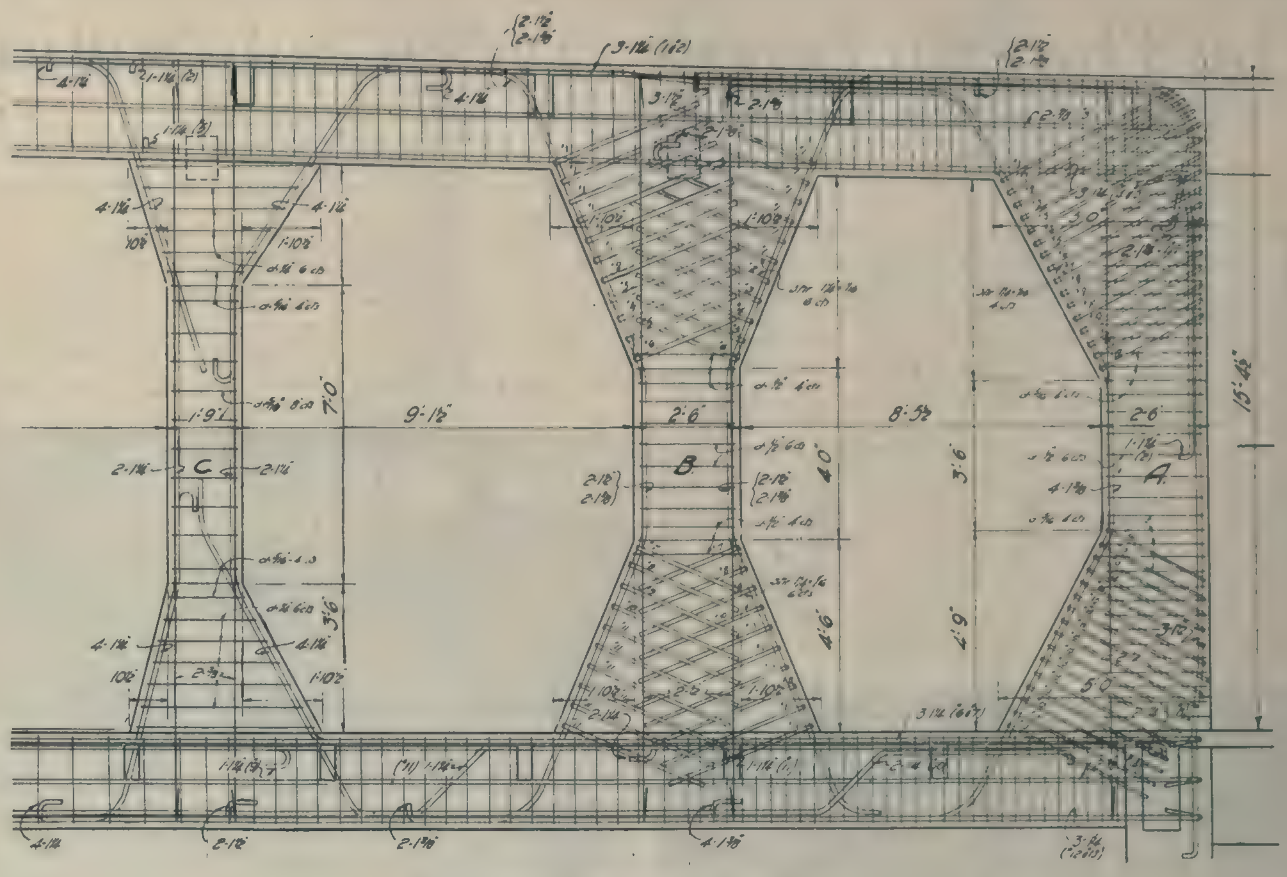
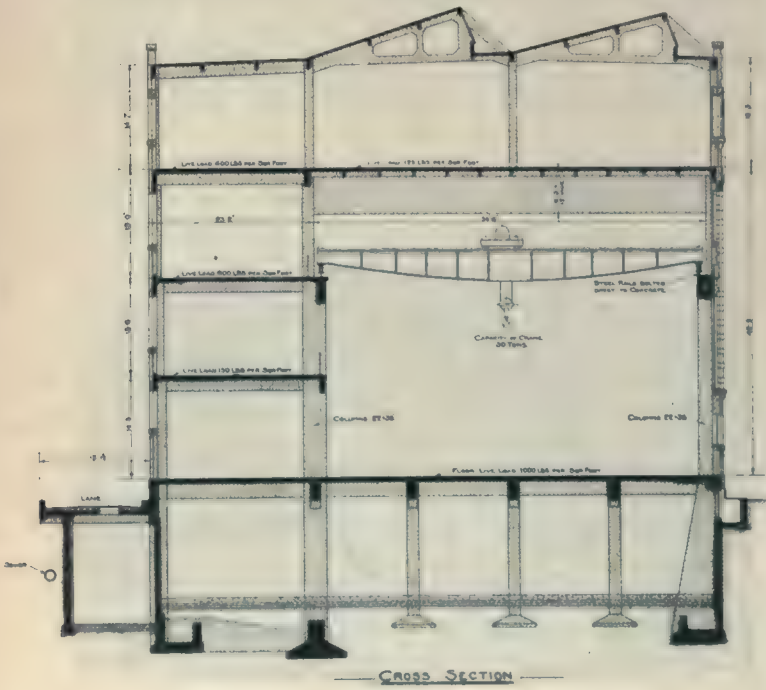


Fig. 3—Showing trussed wall on east elevation.



Working details of truss between 4th floor and roof.

from end to end. Several unusual features for reinforced concrete were worked out in the design. It will be noted that the footings supporting the interior columns carrying the crane rail are through sections, and are tied with a cantilever beam to the outside wall footing. This was designed to overcome the overturning tendency on the outside footing, due to the eccentric loading, shown on the left of this figure. Another example of the treatment a footing receives when it cannot be spread beyond the building line is indicated by the opposite wall, shown on the right of the figure. In this case the engineers have battered the inside pilasters, distributing the load evenly over the column footing. Still another interesting feature is the long 50 ft. clear span beams carrying the fourth floor and supporting the saw-toothed roof. These beams are 16 in. wide, 6 ft. 3 in. deep, and have the floor slab thickened on either side to increase the T-beam reaction. It is reinforced with ordinary 1¼ in. round sections bent to detail on the job, with 3/8 in. round iron stirrups. The beams are built with a camber of 1/300 to 1/360 of their span, giving them approximately 2 in. of a crown.


Live Load 400 Lbs per Sq. Foot
Live Load 400 Lbs per Sq. Foot
Live Load 150 Lbs per Sq. Foot
Steel Rails bolted direct to Concrete
Capacity of Crane 30 Tons
Floor Live Load 1000 Lbs per Sq. Foot
Lane
CROSS SECTION

Cross-section--Note cantilever beam to footings.

Trussed Wall at East End

A working drawing showing the steel reinforcing to the trussed wall at the east end, supporting the roof, is reproduced. The object of this particular construction was to dispense with two heavy beams, one to the fourth floor and one to carry the roof load, which would require considerably more concrete and steel than the trussed construction shown. In the event of future additions the end wall can be taken down and the crane rail extended without interfering with the present structure. The only other examples of this type of truss construction in Toronto are in the Trust and Guarantee Building, recently described in the Contract Record, and in the new Masonic Temple, Upper Yonge Street.

The exterior brick work facing Duncan Street is laid in Flemish bond, alternate stretcher and header, the stretchers being red-faced brick, the headers black. This, with the blocked-out corners and the blue Ohio stone trim, gives a very sturdy and massive appearance to the building. The remaining brick work is laid in old English bond, three courses of stretchers and one course of headers. The interior walls throughout are lined with buff pressed brick, with a wainscotting of white glazed brick, 4 ft. high, capped with two courses of brown glazed brick. The reveals and soffits of the windows and other openings are built of bullnose brick, the sills in some cases being of cement of the same profile. The interior walls around the stair wells are built of terra cotta, and will receive a cement stucco treatment to match the brick walls, the wainscotting effect being carried out with glazed tile. The stairs are of concrete, and will have metal treads and ornamental iron handrails. The soffits and ramp sections will be furred and lathed with high-rib before receiving cement plaster. The floors throughout the ground floor and corridors will be of 9 in. x 6 in. red Cornish floor tile, laid in cement mortar. Metal sash, with transparent wire glass and Kalamanied iron doors, are used on the respective openings. The roof covering will be a three-ply, built-up asbestos roof, which will be rolled into a hot asphaltic mixture, after the cement surface has received a penetrating coat of asphalt cement.

Personnel

Messrs. J. H. Wickett, Ltd., are the general contractors, carrying out this work under the Toronto Hydro-Electric Commission's supervision. Mr. F. G. Engholme, Excelsior Life Building, the Toronto representative of L. J. Mouchel & Partners, is the reinforced concrete engineer.

Tower Design for Transmission Lines

Study of Typical Structure and Stress Diagrams—Descriptive Information of a Variety of Designs

By Lieut. E. T. Driver and E. V. Pannell, Assoc. Mem's. I. E. E.

IN the following article it is proposed to take up the question of the various types of line supports. First and foremost among these is the wood pole.

It has been pointed out by Mr. R. D. Coombs ("Pole and Tower Lines," McGraw, New York) that the wood pole is very nearly ideal as a line support because the stresses it has to carry are almost identical with those which Nature designed the tree to withstand. The difference is, however, that the tree is permeated with living sap, whereas the pole is not, hence the elasticity of the latter will probably be lower, and unless its cells are impregnated it will be subject to decay. Since the primitive days of power transmission, when poles were felled and trimmed right along the site of the line, the selection of poles has been more carefully studied, with the result that certain materials, e.g., white cedar, red cedar, and chestnut, have been found from their natural impregnation, to be most resistant to decay, and have practically become standardized wherever they are readily obtainable. In view of the extended use of wood poles in Europe for telegraph and power lines, the practice of impregnating the whole pole as followed in the old world is of interest. The specification of the British Board of Trade states: "Poles shall be sound winter-felled red fir, free from long knots or other defects, and with the natural butt, and shall be well injected with creosote." The standard quality of creosote or wood tar injected amounts to 10 pounds per cubic foot of pole. In addition, the butt and gains are frequently painted with a coating of hot Stockholm tar. Poles treated in this manner have been found to yield a life of thirty years or more.

In America it is now universal practice to treat the butts and crossarm gains with carbolineum; and, in view of the increased demand for reliability and the growing cost of renewals, it is probable that all poles will, sooner or later, be completely impregnated in a tank, as is done in England. Not the least advantage of a thorough treating process is that it places a cheap pole lumber, such as pine or Douglas fir, almost on a par with cedar, in respect of durability.

Wood poles offer much less diversity than specially-designed steel transmission structures, as they are purchased in a limited number of stock sizes, against specifications covering size, straightness, and general freedom from defects. Most of the cedar poles in use for modern transmission lines fall within the classification A of the National Electric Light Association (see Fig. 1). Such poles as are covered by this specification will readily sustain the stresses arising from a three-phase circuit of No. 4/0 copper on spans of 200 feet. Heavier conductors will be taken care of by the use of the same pole on a shorter span length. With the high transmission pressures now in use a double circuit cannot be satisfactorily mounted on a single pole; even with a single circuit the limit of a pole is reached at around 50,000 volts, beyond which the crossarms become too long. This problem is met by bracing two poles together in the form of an H, with one horizontal crossarm across the top. This type of construction is being used by the Appalachian Power Company (80,000 volts), Central Colorado Power Company (100,000 volts), and the Montana Power Company (100,000 volts). This construction provides a reserve of stability so that the span length can be reasonably increased. For corner and dead-end stresses the construction is still further modified by the use of a

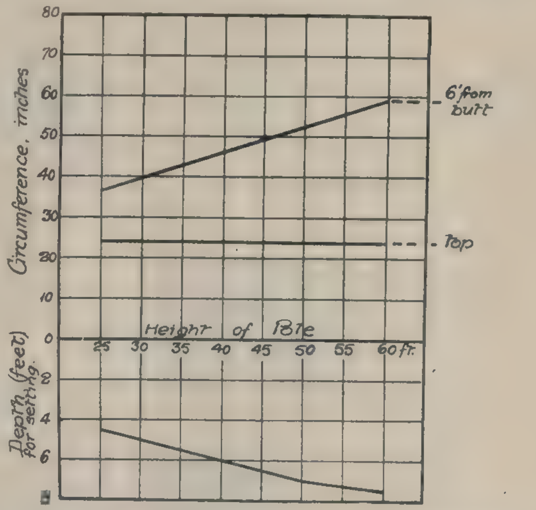
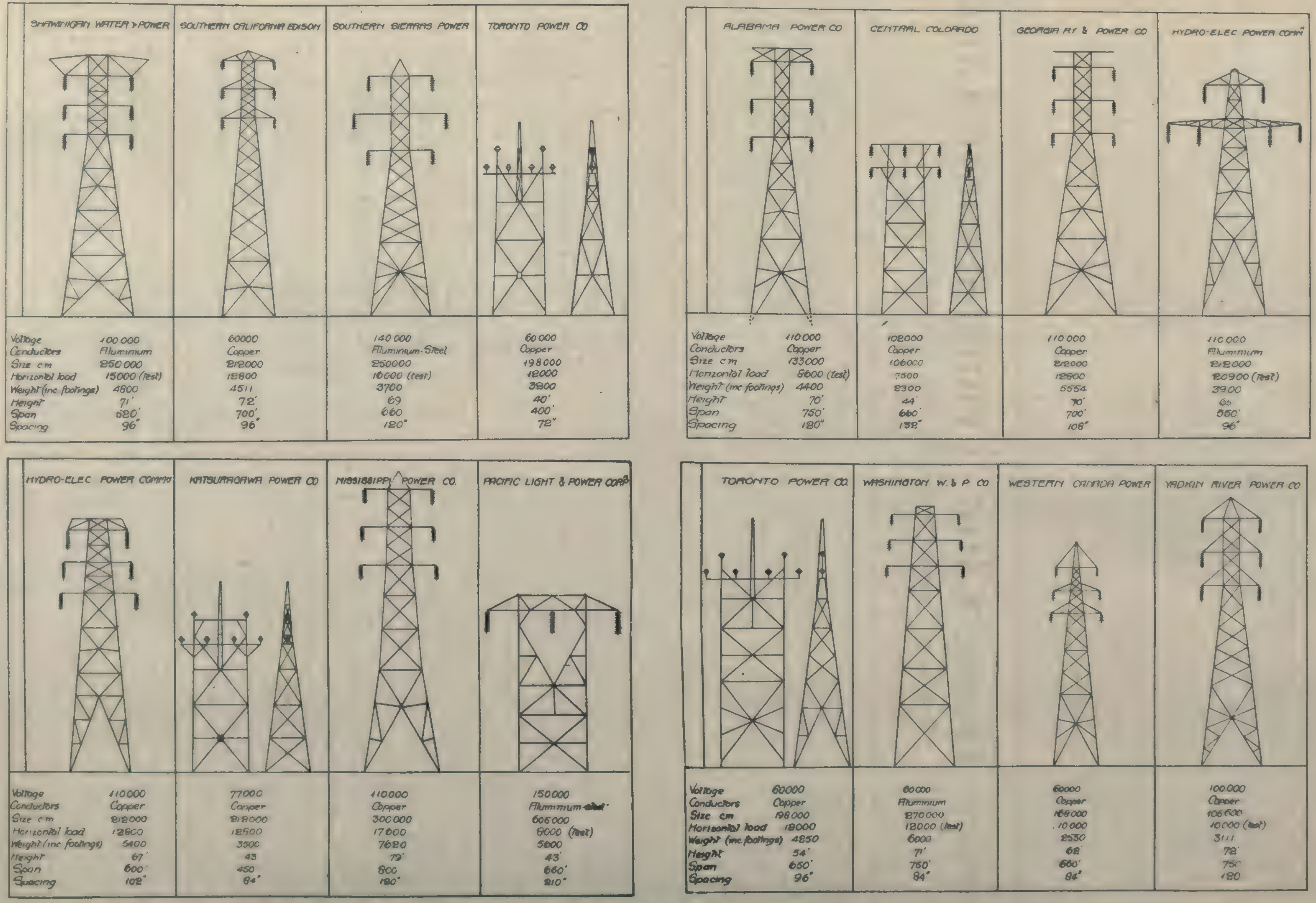


Fig. 1.—Proportions of cedar poles (class A, N.E.L.A. specification)



	SHAWINIGAN WATER & POWER	SOUTHERN CALIFORNIA EDISON	SOUTHERN SIERRAS POWER	TORONTO POWER CO
Voltage	100 000	60000	140 000	60 000
Conductors	Aluminum	Copper	Aluminum-Steel	Copper
Size c m	250 000	212000	250000	198000
Horizontal load	15000 (test)	12800	10000 (test)	12000
Weight (inc footings)	4800	4511	3700	3800
Height	71'	72'	69	40'
Span	520'	700'	660	400'
Spacing	96"	96"	120"	72"

	ALABAMA POWER CO	CENTRAL COLORADO	GEORGIA RY & POWER CO	HYDRO-ELEC POWER COMM'N
Voltage	110 000	102000	110 000	110 000
Conductors	Copper	Copper	Copper	Aluminum
Size c m	133000	106000	212000	212000
Horizontal load	8600 (test)	7500	12800	20900 (Test)
Weight (inc footings)	4400	2300	5554	3900
Height	70'	44'	70'	65
Span	750'	660'	700'	550'
Spacing	120"	132"	108"	96"

	HYDRO-ELEC POWER COMM'N	KATSURAGAWA POWER CO	MISSISSIPPI POWER CO.	PACIFIC LIGHT & POWER CORPN
Voltage	110000	77000	110000	150000
Conductors	Copper	Copper	Copper	Aluminum-[illegible]
Size c m	212000	218000	300000	606000
Horizontal load	12800	12900	17600	8000 (test)
Weight (inc footings)	5400	3500	7620	5600
Height	67'	43	79'	43'
Span	600'	450	800	660'
Spacing	102"	84"	180"	210"

	TORONTO POWER CO.	WASHINGTON W. & P CO	WESTERN CANADA POWER	YADKIN RIVER POWER CO
Voltage	60000	60000	60000	100 000
Conductors	Copper	Aluminum	Copper	Copper
Size c m	198 000	270000	168000	106 600
Horizontal load	18000	12000 (test)	10000	10000 (test)
Weight (inc footings)	4850	6000	2550	3111
Height	54'	71'	62'	72'
Span	650'	760'	660'	750'
Spacing	96"	84"	84"	180

Fig. 2—Some idea of the diversity of tower designs may be obtained from these diagrams and the descriptive information accompanying each.

four-pole structure mounted on a square base and guyed.

However, notwithstanding the simplicity and economy of wood pole lines, steel towers are now standard practice for modern high-tension lines. A span of 800 feet can easily be handled by one steel tower carrying two circuits, whereas H poles mounted every 200 feet would be necessary to carry one of these circuits only. The total number of poles replaced by one tower would, therefore, be 16. Further, the tower line would require six insulators per 800 feet, whilst the pole line would necessitate 24. The difficulty of obtaining reasonably good deliveries on steel shapes has recently been the reason for the installation of several important transmission lines with wood poles, but this condition is only a temporary one.

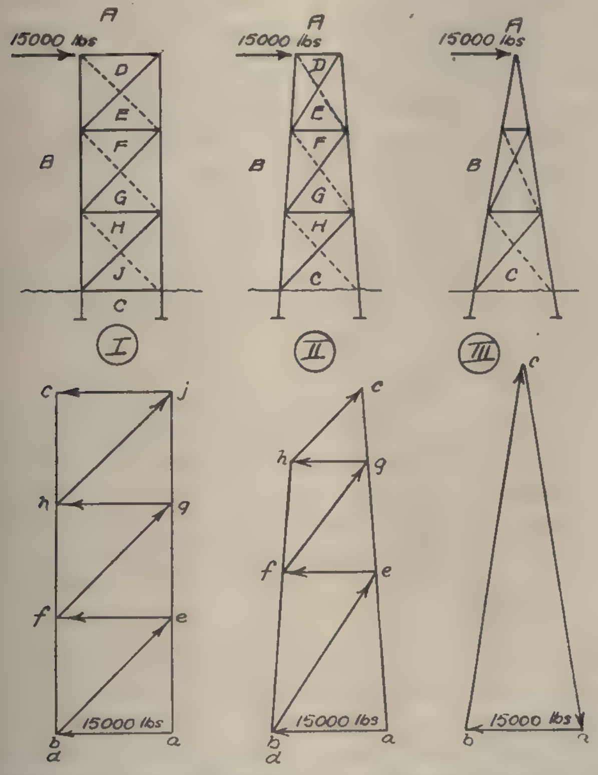


Fig. 3—Structure and stress diagrams for three elementary types of transmission line towers under concentrated test load of 15,000 pounds horizontal. The dotted ties carry no stress with the load on the side as shown. No allowance for weight.

The first steel tower line to be erected for power transmission was that of the Guanajuato Power Company, in Mexico, in 1903, and the number of towers erected in the succeeding fifteen years is estimated at half a million. During this period the design of the transmission structure has been carefully studied, until its stresses and their distribution are fairly well understood. The principal loads sustained by any transmission line support are of two kinds—(a) transverse, and (b) longitudinal. The first is the total horizontal load due to the summated wind pressure on all the ice-covered wires of a span plus the wind pressure on the structure itself. As already shown, the wind load on the wires is commonly accepted at eight pounds per square foot of the projected area, this including a correction factor for cylindrical surfaces of 60 per cent. On the tower members themselves, the surface being flat, the wind pressure will be 8/.6=13 pounds per square foot, and will be figured upon twice the area of one side. Except in the case of a dead end or corner tower, the longitudinal load (b) is very small, with a well constructed line, but it is necessary to allow for abnormal conditions. Along the line normally the pull on the tower from one side is exactly balanced by an identical pull on the other side. Should two cables swing together and burn off there will be an unbalanced pull on the tower crossarm amounting to the tension in these two conductors just before parting. However, several features come in to reduce this unbalanced pull, and it will be found that it can never be quite as great as calculated on the above basis, and in most instances is probably very much less. As each wire breaks the suspension insulator swings up into line with the next span. This very short additional length considerably relieves the stress. Even in the case of pin type insulators, where there is no such flexible element, it will be found that the cable slips through the tie wire before the tower can yield. Furthermore, from the properties of a suspended wire it is obvious that every fraction of an inch which is added to the length of the catenary will cause a considerable reduction in the tension. Now every transmission tower will yield a few inches without failing, and so automatically relieve the horizontal load.

However, it is considered good practice to assume working conditions a little more severe than they actually are, and the average test requires of a suspension tower that it shall not fail until a pull amounting to the tension in half of the conductors on one side is applied. Except in the case of very small conductors, this stress is considerably greater than the transverse wind load, and forms the basis of the design for the towers. It is obviously unsatisfactory to design a tower with light bracing in one direction and heavier members on the other sides, just because one set of loads is less than the other; the whole structure is figured on the basis of the greater load. Consider a double circuit line of No. 4/0 copper with two 3/8 in. ground wires of galvanized steel strung upon a span of 600 feet. The lateral wind

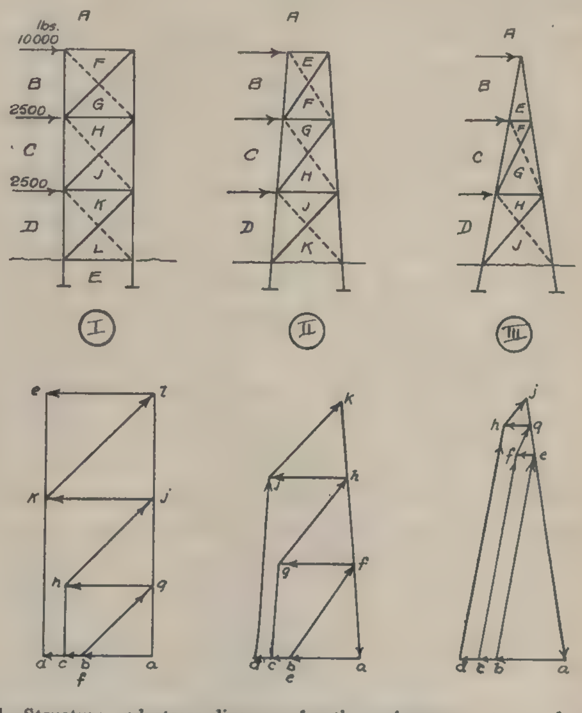


Fig. 4—Structure and stress diagrams for three elementary types of transmission line tower under a distributed (wind) and concentrated (cable) load. Type I. requires the strut LE to carry the horizontal load, but this member becomes less necessary and is seldom used with sloping legs. The tension members, shown dotted, of course come into action when the load is on the other side.

pressure per foot on this size of wire with ½ in. ice will be 1.01 pounds, and the total span will amount to:

$6 \times 1.01 \times 600 = 3{,}640$ pounds.

The load per foot on the 3/8 in. ground wire is .91 pounds, and the total:

$2 \times .91 \times 600 = 1{,}090$ pounds.

Total load (a) = 4,370 pounds.

Now, consider the pull generated by the failure of three cables at the maximum stress. This stress amounts to 30,000 pounds per square inch with copper, and as a No. 4/0 cable has an area of .166 square inches, the tension amounts to 5,000 pounds per cable. When three cables fail, the total load is:

(b) = 15,000 pounds,

or three times the maximum transverse load.

It is common practice to specify a test load applied diagonally being the resultant of loads (a) and (b). However, load (b) if figured upon three conductors failing would seem to provide ample margin of safety.

These foregoing observations apply to suspension towers. Where a corner has to be turned in the line or the cables have to be dead-ended, the structure must have considerably more stability, and it is usual to test such a tower with a horizontal load equal to the failure of all the cables on one side, or, in other words, with double the load of a standard structure. Such towers will be spaced from one every tenth to every sixth span, and still more frequently in uncertain ground, or where the alignment changes. From 70 to 90 per cent. of the line towers will, however, be of the standard type. The function of the tower is to transmit the horizontal load (which usually is assumed to centre on the middle crossarm) down to the footings. Fig. 3 shows diagrammatically how a single concentrated load (such as a test loading) is distributed in the fundamental types of tower. The designs have been simplified as far as possible in order that the principles may be made plain. Most actual towers are a combination of two of these types, being generally similar to I. or II. across the line and to II. or III. in the line direction. Since, as already seen, the stresses in this latter direction form the basis of the design, types II. and III. will naturally be of the most interest. However, the main point to observe in reference to Fig. 3 is the manner in which the stresses are accumulated upon the lower section of the tower legs. Fig. 4 brings the matter a stage nearer to actual operating conditions, as, instead of one horizontal test load near the apex of the tower, a slightly smaller load is applied at the same place, together with a distributed load, due to wind on the structure. This leads to a different distribution of stresses in the bracing, but the main compression load is carried by the lower part of the corner members as before. The bottom horizontal member KL in type I. is dispensed with as being less necessary in the other designs where the sides are battered. However, the lowest diagonal has to carry the same horizontal stress in any case, and a danger exists of making the bottom panel between ground and the lowest strut too long for safety. Ten miles of an important transmission line was wrecked in one night owing to too long an unsupported panel causing the tower legs to shut up like a pair of scissors. It is best for the joint between the bottom diagonal and the tower leg to be made about a foot below the ground surface. This enables the horizontal component of the load to be transmitted to the tower leg without any appreciable shear, and the practice has been adopted by the Alabama Power Company on their recently erected lines.

Apart from this somewhat troublesome horizontal load, the principal stress in the structure is the compression in the legs, and where other things are equal and the footings are good, the tower will not fail until the main compression angle buckles. To ensure the maximum strength against buckling, the legs are frequently cross-braced to reduce to a minimum the unsupported length, and the ratio of this length to the minimum radius of gyration of the section is kept at the lowest practicable proportion. A ratio of 100 represents good design, and 120 is the maximum desirable. Since r for an equal-sided angle is approximately b/5 (where b is the breadth of the angle), then to secure a maximum l/r ratio of 100 the unsupported length must not exceed twenty times the width of the angle. A common size of corner angle for a heavy tower is 4 in. x ¼ in., in which case it will be seen that the maximum length between cross struts should not exceed 80 ins.

Several formulas exist for calculating the buckling stress on a strut and four of those in use for tower work are given below. These are supposed to give the safe load based on a safety factor between two and three:

National Elec. Light Assn. .... $p = 24.000 - 60 \times l/r = 18{,}000$ lb.
Rankine .... $p = 21{,}500 / (1 + l^2/36{,}000r^2) = 16{,}800$ lb.
Alabama Power Co. .... $p = 25{,}000 / (1 + l^2/18{,}000r^2) = 16{,}100$ lb.
European (Tetmajer) .... $p = 22{,}000 - 81\ l/r = 15{,}900$ lb.

The last column gives the actual stresses obtained by using the formula for a ratio l/r of 100, and it will be seen that there is quite a disparity, which is a good reason for adopting a liberal factor of safety in figuring this stress.

Some idea of the diversity of tower designs is afforded by Fig. 2. However, it will be found on analysis that their design is in every case based upon the principles outlined above. The figure for horizontal load given in this diagram refers to the tension in three conductors for a double circuit tower, and in two conductors for a one-circuit structure, except where it is defined as the actual test load.

Flexible towers, or A frames, have not been treated in this article. Their design is based on the distribution of transverse loads only except for the anchor towers, which are figured like any other four-leg structure. The A frame is based upon the presumptions already mentioned, that in the case of two or more cables failing the load on the support is less than that calculated, because (a) the insulators and tie wires will yield, and (b) the tower will yield sufficiently to equalize the stress, and (c) the remaining conductors and the ground wires will afford stability.

As compared with percolating filters treating at a maximum rate of 3,000,000 gallons per acre and under favorable climatic conditions, the activated sludge process of sewage disposal can treat 10,000,000 gallons per acre under the most unfavorable climatic conditions, according to the experience gained from an activated sewage plant at Milwaukee.

The first reinforced concrete ocean-going vessel built in the United States has recently been launched. It is 320 ft. long, 44.6 ft. wide, and 30 ft. deep, and will carry 5,000 tons of cargo.

Effect of Alkali Soils on Concrete

Discussion of Conditions in Western Canada—Chemical Reactions Described—Selection of Aggregate and Ratio of Mixture Important

By J. F. Greene*

WHILE a complete treatment of the durability of concrete would embrace within its scope all of the agencies and conditions which add to or take away from the permanence of concrete, we will confine ourselves to one aspect of the subject, the deterioration of concrete under the action of alkali waters. Although we have limited the location to Western Canada, we consider that it lies within the province of this paper in its preliminary capacity to travel far afield, to ascertain what has been done by those who have been confronted with the same problem, and to profit by their investigations.

The subject is not new; we find mention of a paper upon the action of alkali on cement written in 1891. In 1910 instances of serious deterioration of concrete in the sewers at Great Falls, Montana, came to light. The Montana Agricultural College made a series of experiments to determine the results of the action of alkali salts upon cement, and the United States Bureau of Standards at the same time began an investigation of the action of salt in alkali waters on cements. That the phenomenon of the deterioration of concrete in Western Canada is widespread and of sufficient magnitude to warrant the expense of a thorough investigation is evident from the following brief review of failures reported up to date.

Serious Failures in Manitoba

In the Province of Manitoba in and around Winnipeg there are serious failures to report. In the foundations of the Grain Exchange the deterioration had gone so far as to have involved the replacing of all of the concrete footings at no inconsiderable expense. In the foundations of the Union Bank, where alkali ground water was present, there was deterioration. Further evidence of serious deterioration has been found in the sewers of Winnipeg and St. Boniface. While we have referred to these cases as alkali failures, we are not prepared to offer them in evidence as examples of the action of alkali salts upon well-made concrete. While on the Grain Exchange there was conclusive evidence of lack of care in the grading and handling of the materials, in the cases of the sewers referred to we are not justified in offering an opinion from the evidence at hand.

Although we have received reports of but two failures in Saskatchewan, we feel that a further investigation may bring to light more evidence regarding this evil. Ordinarily the deterioration is found at or below the ground line, in the rear of retaining walls or basement walls, or in sewers. In all cases it is not apparent to the casual observer, and it requires either an actual failure or a careful investigation to disclose the evil.

In Regina an instance of deterioration at the haunch of a concrete arch bridge has been reported. In Saskatoon a basement wall was uncovered, bringing to light serious disintegration. While the ultimate cause of failure was the action of the alkali salts, we have no evidence to offer regarding the primary cause.

Investigation in Alberta

In Alberta the evil has assumed proportions of sufficient magnitude to have warranted the appropriation of $4,000 to begin an investigation to ascertain the most efficacious method of combatting the evil. In many parts of the irrigation belt the concrete in wing walls and foundations which has been in place but a few years has completely disintegrated. From Calgary we have reports of deterioration of sewers, with evidences of alkali as a contributory cause. Here, again, we must offer the facts of the failure with no evidence of the primary cause. I might note in passing that engineers in Alberta who strive to obtain a well-prepared concrete labor under the great disadvantage of being unable to obtain a well-graded, clean sand. The different kinds of sand available, whether bank-run or screened, will run uniformly fine, with a high percentage of silt. How serious is this handicap may be inferred from the fact that the aggregate for concrete used in the eastern edge of the irrigation belt was hauled eighty miles from a pit near Calgary. Because a large part of the concrete which has been placed in Alberta without engineering supervision has been made from a bank-run aggregate, poorly graded and not washed, we may anticipate deterioration where this concrete shall chance to come within the sphere of activity of alkali salts.

Summing up the above, we find conclusive evidence of deterioration of concrete in the presence of alkali salts in Manitoba and Alberta, and an outline of a case in Saskatchewan.

The Chemical Action

The phenomena accompanying the action of the salts of alkali water upon concrete are the withdrawal of the lime content from the cement with a complete loss of the binding power which the cement had possessed. The lime combines with the SO_4 content of the alkali salt to form a new substance, which, instead of binding the aggregate together, requires more space than the lime in its original form, thereby tending to force the aggregate apart. In the case of the deterioration on the Grain Exchange all adhesion had been lost, and one might easily have removed the stones of the aggregate by hand.

Disease Must Be Cured

Because of the fact that concrete is a building material upon which the engineers of this region have placed the stamp of approval, and because a disease of concrete of serious proportions has developed, it is incumbent upon the engineering fraternity to know the characteristics peculiar to this disease and the conditions under which it flourishes; to ascertain what means may be employed to prevent the disease, and not only to make use of these means, but to spread the knowledge acquired throughout the entire field of concrete activity.

While entering upon this investigation with open minds, we are aware of a widespread conviction among engineers that a well-proportioned, properly-placed concrete will resist the action of the salts of alkali water, and that, acting under this conviction, engineers have designed and installed concrete structures involving large expenditures of money, having created in the minds of their employees the presumption that concrete was a permanent building material. It is then the object of this investigation to determine whether it is possible and economical with the materials at our disposal, and with the exercise of due care in the handling of these materials, to produce a concrete which will resist the action of the alkali waters, or whether it is either necessary or even conservative in the light of present knowledge to recommend the use of a waterproofing coat for concrete in places where alkaline salts are present.

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*Construction Engineer, Carter-Halls-Aldinger Co., before C. S. C. E. Winnipeg.

The Most Active Agents

Alkali is a term used to designate the soluble salts that accumulate in regions of little rainfall. They are formed by the disintegration of rocks, and are found in the soils as well as in the drainage water which reaches them from the soils. The sulphates of magnesium, sodium, and calcium are the best known of these, which, together with the chlorides, are the most active agents for the disintegration of concrete.

Investigations have been confined for the most part to the action of either individual salts or several of the salts combined in solution upon cement or upon cement mortar. Having determined that the disintegration of the concrete under the action of alkali waters was due to the action of the salts upon the cement content of the concrete, investigators have observed the action of concentrated solutions of alkali waters upon cement and cement mortars, with a view to concluding from the results of the tests the probable action of the alkali upon porous concrete. Series of tests based upon this assumption have been conducted at the University of Montana, the University of Wyoming, and the University of Colorado. A most comprehensive series of tests was made by the United States Bureau of Standards, the results of which are embodied in a complete report issued in 1912. We are not concerned at this time with the details of these reports, only in so far as we may conclude that they have established certain definite hypotheses which need no further proof, and from which we may proceed as a starting point for future investigation.

Porous Concrete Readily Deteriorates

We have concluded after a careful perusal of the information offered in the various reports of the tests showing the action of alkali water upon cements that we are in agreement with the authors of all of the reports in the conviction that alkali waters, if allowed to permeate through masses of concrete, will cause ultimately complete deterioration of the concrete. The instances of failure already adduced in the different provinces of Western Canada offer further convincing evidence in support of this conclusion.

We may, then, logically confine our activities to an investigation of the action of alkali waters upon a well-made and well-proportioned concrete, with a dense, non-porous surface.

The only experimental evidence which we have obtained from this aspect of the subject was found in a report of the United States Bureau of Standards, dated November, 1917.

A series of concrete blocks of a selected aggregate in the proportions of 1:1½:3 and 1:2½:5 were made at a central laboratory, and, after curing, were placed on eight different projects in the alkali region of the United States, extending from the northern boundary to the Rio Grande. These blocks were placed in the soil at locations where the ground waters were known to contain alkali salts, and where the concrete would be freely exposed to the action of the alkali waters. Other concrete blocks of the same proportions—1:1½:3 and 1:2½:5—were made from the aggregates obtainable at the various projects, and in common use in the various localities as ingredients for concrete. While these blocks were carefully moulded, no mechanical grading for maximum density was attempted. These blocks were exposed at the same locations with those containing the selected aggregate.

In this way an opportunity was afforded not only of comparing the action of the salts upon well-proportioned and well-made concretes, with varying mortar contents—i.e., 1:1½:3 against 1:2½:5—but also of comparing the scientifically-prepared concrete with that brand which would be held in each locality, in the common acceptation of the term, as "good concrete."

The report contains observations made after one year's exposure.

Well-Made Concrete, Rich in Cement, Not Affected

There has been no evidence of disintegration in those blocks made from the selected aggregate in the proportion of 1:1½:3. Of the blocks made from the selected aggregate in the proportion of 1:2½:5, four out of a total of thirty blocks have shown indications of disintegration.

While the comparison based upon the above evidence is in favor of the 1:1½:3 as against the 1:2½:5, we do not feel that the evidence is complete enough to warrant us in drawing a conclusion.

Reverting now to the blocks made from the local aggregates—on two of the projects—all of the blocks of both proportions have shown indications of alkali deterioration. Of the blocks prepared in the proportion of 1:1½:3, ten out of thirty-two blocks—about one-third of the total number—have given evidence of deterioration, while eighteen out of thirty-two of the 1:2½:5 blocks—almost two-thirds of the total number—have shown signs of failure.

From these tests we may reasonably conclude that it is conservative to assume that concrete made from local aggregates without mechanical grading may be porous and liable to disintegration in the presence of alkali waters. While not warranted in drawing a conclusion regarding the comparative resistance to deterioration offered by concretes with varying proportions of mortar, we feel justified in calling attention to the preponderance of evidence in favor of the concrete with the higher cement content.

From the evidence presented in this report we can offer no conclusion regarding the ultimate effect of the action of the salts on the concrete made from the selected aggregate, because the time allowed for possible deterioration covered a period of only one year. We have no further experimental evidence to report upon this phase of the subject.

Indirect Evidence

In the absence of direct and definite evidence upon the subject, it may be profitable to consider indirect evidence, which, thought not of itself able to produce conviction, yet may be of sufficient value to confirm a conclusion already suggested.

Under this category there may be adduced an argument drawn from the fact that there has been an opinion held in common by the engineering world, that well-proportioned, properly-made concrete will resist the action of alkali waters. Such an opinion widely held throws the burden of proof upon an objector, and establishes a presumption that the opinion has some basis in fact.

In support of this presumption we may offer the following contentions: The fact that, although in alkali regions, there are many evidences of the failure of concrete, yet there are many concrete structures in the same regions exposed under similar conditions which have given no signs of deterioration.

Further confirmation of the widely-held opinion that good concrete will resist the action of alkali waters has been based upon the known facts regarding the action of the salts of sea water upon concrete. The active salts in sea water are the same as those in alkali waters, namely, the sulphates and chlorides of magnesium and sodium. While innumerable instances of failures of concrete in sea water can be adduced, there are many piers and walls in salt water which have been in service for many years, and which are intact, showing no evidence of deterioration.

Calcium Carbonate as a Protection

The scientific basis for the assumption rests upon the contention that in a well-proportioned, properly-made concrete the calcium content of the cement at the surface exposed to the air combines with the CO_2 of the atmosphere to form calcium carbonate, a salt which is practically insoluble in the presence of alkali salts. While it may be contended that calcium carbonate is soluble in sodium chloride, the fact remains that the carbonate surface of concrete in salt water, when not removed by mechanical abrasion, will withstand the action of the sodium chloride of the sea water. According to this theory, then, a dense, non-porous skin of calcium carbonate is formed on the surface of good concrete; and upon the integrity of this surface depends the life of the concrete.

This is a brief statement of the indirect evidence bearing upon this phase of the subject. Inasmuch as the direct and indirect evidence combined lead to no definite conclusions, further investigations are needed.

Further Investigations Needed

The details of the plan to be adopted in an investigation are a matter for individual opinion, and I will take this opportunity of outlining a modus operandi. Locations in the Western provinces in which it is evident that alkali salts are present in the ground water should be designated. At these locations concrete blocks should be placed in the soil exposed to the action of the alkali waters. At each location the blocks should be of three kinds—first, blocks moulded under the supervision of an engineer in the proportion of one part of cement to five or six parts of the combined aggregate obtainable in the district, the parts of the sand and gravel to be so proportioned as to give a concrete of a maximum density for the given cement content and the concrete to be placed with as small an amount of mixing water as will allow of being properly worked.

A second set of blocks should be made by a local contractor from the same aggregate, in the proportion of 1:2:4, and of the consistency which is the common practice in the locality. These blocks should be fair samples of the concrete used in that district.

A third set of blocks of a leaner mix and with the various blocks protected with different waterproofing coats, should be exposed under the same conditions. Observations made at intervals of a year should be recorded, passed upon by a committee, and published.

The objects aimed at in this plan are to ascertain first whether a well-made concrete, proportioned from local aggregates in a manner which is commercially practicable for both large and small jobs, will resist the action of the alkali ground waters which are present; and, second, whether the ordinary commercial concrete obtainable without engineering supervision will withstand alkali salts.

Should these experiments show that one or both classes of concrete will deteriorate, then it may be necessary to recommend the use of a waterproofing coating, and the experiments with the third class of blocks will offer evidence upon which to base recommendations as to the kind of waterproofing to be employed.

It may be pertinent at this time to revert to the fact that, while the information from an investigation may not be available for several years, we are confronted with our immediate problem of the position which engineers should assume in the light of our present knowledge or lack of knowledge. We have been forced to the conclusion that a porous concrete will disintegrate under the action of alkali salts.

General Opinion Concrete Is Fool-proof

Yet it is common knowledge that a large proportion of the concrete in the Western provinces has been placed either with inadequate engineering supervision or with no supervision at all. The natural results of such a policy have been the widespread opinion held among contractors, foremen, and laborers that concrete is a fool-proof material, and that special care in the making of the concrete is not necessary. Reliable knowledge of the effect upon the density and compressive strength of concrete, of varying the proportions of cement, sand, gravel, the amount of water, the method and time of mixing, and the method of placing, is rare among foremen, workmen, and even among subordinates employed by architects and engineers to supervise the work.

Under these conditions it is reasonable to suppose that much of the concrete placed in foundation work has been of a porous quality, and we may anticipate reports of failures when such concrete comes within the sphere of action of alkali waters.

Examine Soil and Ground Water

The conservative position, then, for the engineer who is responsible for the placing of concrete in foundation and sub-soil work should entail the examination of the soil and ground water for alkali salts, careful supervision of the proportionings and handling of the material to give a dense concrete with a non-porous surface, and an adequate provision for the removal or drainage of the ground water.

In conclusion, we wish to apologize again for having been unable in the time and with the means at our disposal, to obtain more convincing evidence on this subject. We are painfully aware that we have offered in evidence only one series of facts, which should have a place in a paper upon the durability of concrete in Western Canada, namely, the announcement of failures of concrete, in the various provinces; and that the body of this paper has been built up from evidence dealing with conditions prevailing outside of the Dominion which we have assumed as on a par with those which prevail in Western Canada. May we not offer this confession of our inability to obtain necessary information upon this important subject as an argument in favor of an early beginning of a complete investigation of the action of the salts of alkali waters upon concrete?

Joint Professional Meeting of Toronto and Ottawa Branches C. S. C. E.

THE program of the first general professional meeting of the Canadian Society of Civil Engineers, which is being held under the combined auspices of the Ottawa and Toronto branches of the society is given below. The meeting will be held in the Chemistry and Mining Building of the University of Toronto, on March 26 and 27. All of the papers will deal more or less directly with the present fuel and power situation:

Tuesday, March 26

9.30 a.m.

Arrangements will be made for delegates to visit the plant of Canadian Aeroplanes, Ltd., on Dufferin Street, or the plant of British Forgings, Ltd., at the foot of Cherry Street. Those desiring to take advantage of these inspection trips are requested to notify the secretary of the Toronto branch in advance, stating preferred trip, so that proper arrangements may be completed. The parties will assemble at the society's rooms, 96 King Street West, at 9.30 am.

2 p.m.

Opening Address, by Sir William Hearst, Prime Minister of Ontario.

2.15 p.m.

The Fuels of Canada—Mr. B.F. Haanel, chief of Fuel Division, Department of Mines, Ottawa.

Discussion—Mr. L. M. Arkley, M. Can. Soc. C.E., assistant professor of mechanical engineering, Toronto University.

2.45 p.m.

Transportation From the Fuel Viewpoint—Mr. W. N. Neal, general secretary of the Canadian Railway Association for National Defence, Montreal, Que.

3.15 p.m.

The Rational Development of Canada's Coal Resources—Mr. W. J. Dick, A.M. Can. Soc. C.E., mining engineer of the Commission of Conservation, Ottawa, Ont.

3.45 p.m.

Utilization of Peat—Mr. John Blizard, A.M. Can. Soc. C.E., technical engineer Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, Ottawa, Ont.

Discussion—Mr. James Milne, M. Can. Soc. C.E., mechanical and electrical engineer, Department of Works, City of Toronto.

4.30 p.m.

The Low Temperature Carbonization and Briquetting of Bituminous Coals—Mr. E. Stanfield, Division of Fuels and Fuel Testing, Mines Branch, Department of Mines, Ottawa, Ont.

8 p.m.

An Illustrated Address on "The Erection of the Quebec Bridge"—Mr. George F. Porter, M. Can. Soc. C.E., engineer of construction, St. Lawrence Bridge Company, Montreal, Que.

Mr. C. A. Macgrath, Fuel Controller of Canada, has been requested to address the meeting on Tuesday evening, and his attendance is hoped for.

Wednesday, March 27

9 a.m.

Ontario's Efforts to Relieve the Fuel Situation—Mr. Albert Grigg, Deputy Minister, Department of Lands and Forests, Ontario, Toronto, Ont.

9.30 a.m.

Wood as an Emergency Fuel—Mr. E. J. Zavitz, Provincial Forester, Ontario.

10 a.m.

Gas for Light, Heat, and Power—Mr. Arthur Hewitt, general manager Consumers' Gas Company, Toronto.

10.45 a.m.

Central Heating as a Means of Conserving Fuel—Mr. F. G. Clark, M. Can. Soc. C.E., chief engineer, Toronto Electric Light Company, Toronto, Ont.

11.15 a.m.

Oil Fuel and the Possibilities of Its Use—Mr. R. W. Caldwell, chief mechanical engineer, Imperial Oil, Ltd., Sarnia, Ont.

2 p.m.

Canada's Water Powers and Their Relation to the Fuel Situation—Mr. J. B. Challies, M. Can. Soc. C.E., superintendent of Dominion Water-Power Branch, Department of the Interior, Ottawa, Ont.

Discussion—Mr. H. G. Acres, M. Can. Soc. C.E., hydraulic engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

2.45 p.m.

Railway Electrification—Mr. John Murphy, M. Can. Soc. C.E., chief electrical engineer, Department of Railways and Canals, Ottawa, Ont.

3.30 p.m.

The Possibilities of the Relief of Fuel Consumption in Canadian Industry by the Increased Use of Hydro-Electric Energy—Mr. J. M. Robertson, M. Can. Soc. C. E., director, Southern Canada Power Company, Montreal, Que.

4.15 p.m.

The Possibility of Lessening Fuel Consumption in Canada by the Adoption of Electrical Heating—Mr. P. H. Mitchell, A.M. Can. Soc. C.E., consulting engineer, Toronto, Ont.

8 p.m.

Smoker at rooms of the Toronto Branch, 96 King Street W. Refreshments and a program will be provided.

The Use of Roller and Belt in Finishing Concrete Roads

By H. E. Bilger*

MINOR differences of opinion concerning the particular kind of roller and belt, as well as variations in the methods of using them to finish concrete roadways, were brought to light at a recent conference of the engineers in charge of the seven highway districts of Illinois, called for the purpose of evolving specifications that would result in the desired class of work. Upon investigation, however, it has been found that these differences are due principally to variations in humidity, temperature, character of aggregates (whether gravel or crushed stone), experience of the workmen and other factors mainly of local or particular nature.

Proved Satisfactory in Illinois

The practice of finishing concrete roads by rolling and belting had become quite general in Illinois in the latter part of the construction season of 1917. The finished surfaces have proved so satisfactory and the method so economical that it was decided to require the roller and belt finish on all concrete road work next season. From notes taken at the above-mentioned conference I have written the specifications below, which represent the concensus of the seven district engineers.

They will be incorporated into the revised edition of the department's specifications for concrete roads, and will therefore be used in the construction season of 1918. The new specifications follow:

"After the surface of the concrete pavement has been struck off to the proper cross-section it shall be finished by rolling and belting. The roller and belt shall meet with the approval of the engineer.

"The belt shall be of canvas-rubber composition, from one to four-ply, and shall have a width of from 6 to 10 in. and a length at least 2 ft. longer than the width of the pavement. Preferably two belts of different weights should be used, the lighter one being used for the last belting.

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* Road Engineer, Department of Public Works and Buildings, Springfield, Ill.

"The roller shall be of smooth steel from 8 to 12 in. in diameter, and shall have a total length of at least 4 ft., but preferably 6 ft. The weight shall not exceed ¾ pound per inch of length for a roller 8 in. in diameter, nor 1 pound for a roller 12 in. in diameter. For roads not more than 15 ft. in width the roller may be operated by a handle so designed and used as neither to increase nor decrease the pressure coming upon the concrete from the roller. For roads of greater width the roller should be operated preferably by ropes.

Road Belted Three Times

"Immediately after the surface of the concrete pavement has been struck off with a template, it shall be belted over once with a combined crosswise and longitudinal motion, using long, vigorous strokes of the belt. At this belting the longitudinal motion shall be slight, but it may be increased in succeeding beltings. Care shall be taken not to work the crown out of the pavement nor to permit the edges of the belt to dig into the surface of the concrete.

"After an interval of 10 to 20 minutes, or as much longer as the engineer directs, the roller shall be operated slowly transversely from one edge of the pavement to the other, and then back over the same area. A one-half lap shall then be made and the rolling continued as before until the entire surface has been rolled. In moving the roller to make the lap great care shall be taken not to mar the concrete.

"Immediately after the rolling the surface shall be belted a second time, and about 15 minutes later, or as the engineer directs, it shall be rolled as before.

"Just before the concrete obtains its initial set the surface shall be given a finish by a final belting, in order to produce a uniform surface of gritty texture. This belting shall be of short, rapid, transverse strokes having a sweeping longitudinal motion.

"The use of a short handled wooden float as a substitute for the belt will be permitted only by the written authorization of the engineer. If such permision is granted, the finishing shall be carried on from a suitable bridge, no part of which shall come in contact with the concrete. The use of a long handled wooden float is specifically prohibited.

"The edges of the pavement shall be finished carefully with an edger of about 1 in. radius."—Engineering News-Record.

Carrying a River Underground

A novel piece of engineering, recently completed in connection with the building of an aviation field in England, is described in the Scientific American. The site selected was a wooded park, bisected by a stream about 30 feet wide and 2 feet deep. This waterway is largely artificial in character and is 11 miles long.

The decision to convert the park into an aerodrome made it necessary to divert this river, which, being raised above the level of the ground where it crosses the park, presented an obstacle as well as a danger. Had the river been running in a natural bed below the level of the ground, instead of in an artificial channel above the ground level, it could have been merely covered over. The need for putting it at a lower level led to the decision to carry it underground through the aerodrome by means of a reinforced concrete inverted syphon, and this plan having been approved of, a detailed scheme was got out. The conduit is 1,055 feet long, but in addition to the covered-in portion, there is a retaining wall and river diversion beyond which makes the total length of the work just a quarter of a mile.

It was decided, in order to facilitate the cleaning out of the underground channel, to have a double syphon. The gradient adopted in laying it is one in 2,000. It is designed for a flow of 27,000,000 gallons in 24 hours, and a small waste weir has been provided above the intake to carry away any surplus water. The ground being nearly all gravel, the excavation was comparatively easy, and the operations which were started at the end of May, 1917, were completed in five months. The only difficulty that occurred arose from the very heavy rainfall at the end of July, when nearly five inches of rain fell in four days, flooding the trench and rendering necessary the installation of additional pumping machinery. As only one section of the culvert will be closed at a time for cleaning purposes, it was necessary to provide only one penstock at each end, and thus considerably reduce the cost of the work. A drainage ditch has been provided for use when it is necessary to empty one of the conduit sections, the waste water running away into the Thames.

Montreal Branch C. S. C. E. Officers Elected

The result of the ballot for officers and committee of the Montreal Branch of the Canadian Society of Civil Engineers was announced at a meeting held in Montreal on March 14. Mr. Walter J. Francis was elected chairman, Mr. Arthur Surveyer vice-chairman, and Mr. F. B. Brown secretary-treasurer, with the following executive committee: Messrs. F. P. Shearwood, W. Chase Thompson, H. G. Hunter, L. G. Papineau, O. Lefebvre, and K. B. Thornton.

Mr. H. H. Vaughan, in making the announcement, stated that with the organization of the Montreal Branch of the Society was entering upon a new period of its history, and was commencing the work which came into effect under the new by-laws. From now on the meetings would be those of the Montreal Branch, it being the intention to form civil engineering, mechanical, electrical, and perhaps chemical sections. This would give greater opportunities to the younger members to read papers, his opinion being that the meetings in Montreal had hitherto been too much in the hands of the older members. He asked the younger members to accept the opportunities, as it was desirable that men who made a special study of subjects should read papers on them. The formation of the various sections would provide a method for obtaining a class of paper which the society had not secured in the past.

Mr. W. J. Francis briefly expressed his thanks for his election.

Speaking at the annual dinner of the Canadian Mining Institute, Mr. H. H. Vaughan, president of the Canadian Society of Civil Engineers, congratulated the institute on forming an iron and steel section. There was, he said, no conflict between his society and the Mining Institute, as each could play its part and cooperate in the development of the industry.

William Cowlin & Son have announced the closing of their office in the Mail Building, 106 Bay St., Toronto, until the termination of the war. Communications are to be referred in future to Mr. S. V. Kendall, managing director of the company, at 154 Simcoe Street, where all matters relating to the business will be dealt with.

Letter to the Editor

Kitchener, Ont., March 15, 1918.

Editor Contract Record:

I have noted with interest your article under date March 13, page 211, on the subject "Flood Prevention and Power Production on the Grand River." It is a well established fact that the annual floods on the Grand River are not only a cause of much destruction, but also a waste of a resource of great value.

The original condition of the Grand River watershed was one of dense forestation. On the wide headwater area there were large swamps, hundreds of square miles, which, together with the general forestation, retarded snow-melting, caused absorption of water which the ground slowly gave out in springs, and on the whole made excellent condition for sustained flow of the river throughout the year, with but moderate high-water, not going beyond the immediate channel of the river, in the spring.

The forests have disappeared, and, a particularly detrimental feature, the head-water area swamps have been drained, so that now on snow-melting the water goes with a rush, and if there is rain at the time there is a high flood.

Conservation of the river by restoration of original conditions is out of the question. Any conservation now practicable must be artificial, in the way of storage at times of excess flow, the water to be released as required.

The practicability of economical flow control of a river depends:

(1) On what it is worth to eliminate flood destruction and on the value of other incidental benefits to be derived.

(2) On the cost of regulation, and this is dependent on the physical conformation of the river valley; whether easy or difficult for regulation works, and, as main feature, whether properly adapted sites for storage dams on a large scale, with capacity large enough to catch and retain at least the destructive crest of the flood flow, can be had at the required location or locations on the river.

On the Grand River there is a dense urban and rural population. The damage done by the annual floods, and by occasional later floods, such as the one of the end of June, 1917, is very material. The damage consists both in destruction in the towns and cities and in overflow of farming lands. The diminished flow during periods of drouth very detrimentally affects existing water powers on the river, and also tends to make it a sanitary menace in its pollution.

The extent of the annual loss is uncertain as no definite investigation has at any time been made, and cannot well be made except under government authority. Capitalization of the loss and of the benefit by sustained flow and use of the surplus water will point to economical cost of control.

Investigations by the Hydro-electric Power Commission during the past five years have gone far enough to determine that one unique storage site is available on the Grand River. This is in Pilkington Township, below Elora, and would have a storage capacity of well over two and one-half billion cubic feet, a capacity ranking large as compared with that of many of the most notable irrigation and other river control projects undertaken. The watershed area above the reservoir would be over 400 square miles. This reservoir alone would give sufficient capacity to eliminate the destructive crests of floods for the whole length of river below it, and would, for the upper part of the river, give a minimum flow eight to ten times what it is now. Additional reservoirs are, however, desirable, both on the Conestogo and on the Speed tributaries, if not also on the Nith, which empties into the Grand River at Paris. With such reservoirs on the Conestogo and the Speed additional low water period flow of from 500 to 600 cubic feet per second could be had at Galt, and from there on.

W. H. Breithaupt.

Saskatchewan Highway Expenditure

The Department of Highways, Government of Saskatchewan, will be undertaking a certain amount of reinforced concrete bridge construction work this coming season. Calls for tenders for the specified works will be issued in due course, probably about May 1, and in order to complete these works before the rush of harvest operations commence the department is endeavoring to get the contractors on the work as early as possible, as the opening of the construction season commences on May 1. The department is at the present time making arrangements for the supply of materials (the government supplies in all cases the cement, piling, and reinforcing steel for bridge work). Prices are now being secured from various manufacturers and supply companies for the above. Materials will be laid down at the earliest possible date.

A Bridge Over the River Batiscan

With the exception of a bridge over the River Batiscan, 71 miles above Quebec, the road between Montreal and Quebec is practically completed. At this point the motorist has to use the old system of ferry barge. This is the missing link joining the two ends of the National Road. A steel bridge is to be built at the site, where a wooden bridge was located some thirty years ago. It was learned from good authority that the provincial government has entered into negotiations with the federal government for the achievement of this enterprise, which will be useful not only to the neighboring villages, but also profitable for military purposes. The chief engineer of the Department of Public Works for the Province of Quebec, Mr. L. A. Vallee, has received authorization to prepare plans.

The first bridge over the River Batiscan was covered and of the Howe type. It was erected by Mr. Jacques Normand, from Quebec, who completed it in 1844, at the total cost of $31,536. The total length was 1,240 feet, the width 18.5 feet, with cut-stone abutments and wooden crib piers of 2-inch plank sheathing. It lasted twenty-five years, and was eventually swept away by the freshets. A new contract to rebuild the bridge was signed in 1870, between the provincial government and Mr. Telesphore L'Heureux. The old foundations were used and a wooden through bridge built, the arches being of eliptical form, and a sliding arch of 12 feet long was designed to allow for boat traffic. Since 1885, when it was burned, the ferry barge has been used. In 1912, to improve the ferry at Batiscan, the federal government built two wooden landing piers

The Proposed Mobilization of Constructional Forces for Food Production

An important subject is now being seriously considered by the Federal Government whereby the builders of Canada would be called upon to cultivate large areas of idle lands in the Dominion. This plan has been under consideration for some time and all details are completed with respect to agricultural features and methods of operation.

It requires no very serious study to discover that the constructional forces of our country are practically idle. A very few of the contracting companies are busy; many are semi-latent, while most of them are doing little. The figures with respect to contractors in the building line prove this—namely, that work dropped from $200,000,000 worth of business in 1912 to $34,000,000 in 1917. These figures could easily be doubled if all the construction carried out by builders of railways, roads, canals, sewers, etc., were included along with that of contractors of buildings.

Realizing the existence of this great semi-latent force and believing that there should be some sphere of activity in which this force could be utilized, the problem was to discover what need in the present world situation this force could be employed in alleviating. By a process of elimination the various activities were laid aside until there remained only two—the last need to be eliminated was the getting out of timber from the large limits in British Columbia for the construction of wooden vessels. On investigation this proved to be very great, but it was made clear that the wooden vessel was not the solution of the shipping problem, and that the energies of shipbuilders would have to be largely devoted to the construction of steel vessels. This left only the great need of food production to be considered. On first thought it looked as if the problem was almost impossible of solution, as the work of men engaged in construction seemed to be far removed from that of tilling the soil. Finally, however, the possibilities of working out a complete program whereby this great force could be utilized to fill the world need were realized.

About five weeks ago these possibilities crystalized into a definite plan and since that time Mr. J. P. Anglin, president of the Montreal Builders' Exchange, has devoted his entire time to working out details and completing the plan for the whole project. This involved conferences with the Minister of Agriculture for the Province of Quebec and some of the officials of the Departments of Agriculture in Ottawa and Toronto. The plan has also been placed before the Prime Minister and Chairman of the Privy Council, as well as the Minister of Agriculture at Ottawa. About four weeks ago the plan was submitted to Mr. H. B. Thompson, Chairman of the Canada Food Board, who realizing its possibilities, appointed a committee of the best agriculturists available to study the entire plan and to report upon its feasibility, outline a program of operations and to make recommendations which could be placed before the Federal Government. The committee reported favorably and made strong recommendations which are now being considered.

While the project should undoubtedly be a Federal measure, and carried out on a very large scale, there is every likelihood of its being proceeded with, with private funds, but necessarily on a smaller scale, should the Government decide that it cannot finance the operations.

Any general contractor, or construction engineer, who has carried out building work and construction operations can readily see that, after all, it is not a very far step for the contractor to take when he changes from building to tilling the soil. The contractor's business requires him to carry out a given piece of work in the open in schedule time in accordance with plans and specifications under the supervision of an architect or engineer. Now this project calls for exactly the same organization and requirements, except that the work will be done under expert agricultural supervision using men and machinery.

The idle lands adjacent to big cities might be worked and cropped this season and even idle farms might be worked if it were possible to group them in sufficiently large areas, but the main program calls for very extensive work on the prairies, where the greatest return, both in food and money, can be realized.

It is suggested that the contractors in the various centers who would like to take part in these operations if proceeded with, should join and register at the nearest builders' exchange and that their names should be sent to the Builders' Exchange, Montreal, where the idea originated. This should be done at once in order to show the authorities the existence of the great forces above referred to and their willingness to co-operate, if satisfactory arrangements can be made.

The arrangement of the land for operation in the West is based on the section of 640 acres. The smallest "unit" under this plan would be made up of five or six sections, while a "group" would be composed of four units so that a superintendent or contractor would have charge of at least one group of approximately 12,000 acres. A large contracting organization with a number of skilled superintendents could work any number of groups from three to nine, depending upon ability to organize and secure labor, etc. Several groups under one contractor would be called a "district" and the contractor would preside over this district. In this district he would have, besides an operating head, a timekeeper, bookkeeper, clerk and cost clerk, as well as an agricultural expert. Each district would in turn report to headquarters as the work would be divided into three main sections—operative, technical and financial—all three being under a managing director who would report to a central board.

It is proposed to break up this season 540,000 acres in the West and prepare them for crop in 1919. The program further calls for the breaking up of an additional 540,000 acres in 1919, taking crop from 1,080,000 acres in 1920.

Such a project should be a real factor in the food situation and is worthy of the consideration of the contractors of Canada, as well as the Federal Government. These are days when men of all classes are entering upon work practically foreign to their usual occupations and contractors would be serving the allies effectively in furthering a project so vital to the winning of the war.

Develop Our Own Power Resources and be Independent of Imported Coal

Extracts from Address by Hon. F. B. Carvell, before Ottawa Branch C.S.C.E.

I thank you for the warmth of your reception, but I hardly understand why your president should say I am familiar with engineering matters. You know I am a farmer. Or, perhaps, some of you did not know that. Sometimes I practice law for the purpose of making a living. I have never been an engineer. But, in order to show you how I appreciate the services of the engineer, and to illustrate the need of working under skilled engineering advice, let me tell you a little story about my own experience. About fifteen years ago four or five other gentlemen and myself conceived the idea of developing a water-power. We did not have any waterfall, and we were compelled to build a dam across a stream. We blocked out a rough sketch of how we thought it ought to be built. The dam was 40 feet high and 400 feet across the stream and 125 feet up and down the river. It was too big for cement, so we made an ordinary wooden dam. We hired a practical lumberman to build it for us the way we had worked it out, and when it was finished we thought we had accomplished wonders. But, would you believe me, when the first spring freshet came, half the infernal dam went out, and the loss was a mighty serious one. That was my first experience in any engineering matter, and I paid sweetly for my experience, I assure you. I think that has been about the experience of every man who has attempted to carry on a work of that kind without the advice and service of trained engineers. You have said truly, Mr. Chairman, that this war has demonstrated the necessity of highly-trained technical engineers—perhaps it has demonstrated it more clearly than anything else that has taken place in our day. This war is primarily a war of engineers, and, secondarily, it is a war of science; but without the engineer the science would be of little use. And what is true of the great conflict raging in Europe will be doubly true of the great conflict that must be waged in all portions of the civilized world when the war is over. The war has to go on. Sometimes we are apt to think that there is nothing left to fight for, nothing left to work for. We are apt to think that financial bankruptcy is upon us; that the debts imposed by the war are so great that the world cannot stagger under them. If you sat at the council board, as I do, and tried to figure out what was to happen and how we were to get the money to keep things going, you would almost come to the conclusion that there is nothing to live for. But there is. I imagine that Europe was in pretty nearly as bad a condition after the Napoleonic wars ending in 1815 as the whole world is in today. Yet the world went on; the people lived, worked and prospered—greater prosperity was achieved within a few years after those wars than had been in two thousand years before. So I believe that, after this great struggle is over, while the world will be loaded down with debt, yet there is that in the human race which overcomes difficulties, which takes responsibilities, and works out results. The same thing will happen after this war as has happened before.

There is another field in which, I believe, the wisdom and ability of the engineer must be used in future to a thousandfold greater extent than in the past, and that is in the development of our highways. I know that in many portions of Ontario this problem has been taken up in a much more scientific manner than in other parts of the Dominion, and I would couple with that the Province of Quebec, because they have accomplished wonders there in the development of their highways. But, taking the Dominion of Canada as a whole, I do not think it involves any unjust reflection to say that we are somewhat behind many other portions of the world in the development of our highways.

It is really pitiable to see the waste of good money all over this country in the attempt to make good roads, and that waste is due simply to the fact that they do not engage the services of competent men, men who know how to make good roads. I speak of my own province especially, and I cast no reflections whatever upon the gentlemen who administer public affairs to-day or who have administered them in the past, nor upon the men who have handled the money; but I think I am safe in saying that, purely from the lack of proper engineering knowledge, from one-third to one-half the money used in making roads down there has been absolutely wasted; and I believe, also, that that is true to a great extent of every portion of Canada. There is no public work or service that I know of which requires the trained engineer to a greater extent than our roads. If I had the opportunity to talk to the people all over this country, one thing which I would wish to impress upon them more than almost any other is that the services of the trained engineer should be made use of in our highway construction. I drive through the country and see men spending money in large sums on roads without even providing the most elementary need of a road—drainage. It makes one almost sad to think of it, but if they would spend only a few dollars in securing the advice of men who know how to build roads, they would save large sums in the long run, and would have roads that would be good for years in the future.

I have very hurriedly and hastily discussed some of the things which I look upon as being among the problems that face Canada to-day and that will face Canada when the war is over. I do not think that a man should be considered as aspiring to be called a prophet because he says that the engineer must play a much greater part in the economic life of Canada in the next twenty-five years. Already the engineer in Canada has accomplished wonders. When we look about us and see the wonderful works which have been created by our engineers in twenty-five years we can hardly realize the skill, the high intelligence, and hard thinking required to carry them out. And when we consider also the great works that remain to be accomplished within the next twenty-five years we realize that these works can be carried on economically and efficiently only by engaging in them the services of the trained engineer, and we have some slight conception of the great field of labor which opens before the engineers of to-day. Wonderful results will follow for the country if we utilize the engineer's powers, but there will be a sad retrograde movement if those powers are not utilized.

I deem it a great honor to have had the privilege of addressing you. I had no hope of telling you anything that you do not know yourselves, nor have I attempted to give you advice, for I realize that it would be presumption on the part of a layman like myself to attempt to give advice to members of a learned profession such as yours. But I am pleased, indeed, to have had the opportunity of meeting you, and I am glad to assure you that, as minister of one of the great spending departments of government, I appreciate the services of your profession, and I realize how utterly hopeless would be any attempts of mine to carry on the duties of my office were I not surrounded by men of technical training and skill. This may be a question of policy, and I do not want to talk shop, but, so far as I am concerned, I propose doing nothing in my department except on the advice of the responsible engineers employed to give me that advice. You see, I have profited by my little experience of fifteen years ago—and I know of no way to teach a man so effective as to make him lose twenty-five or thirty thousand dollars. I have learned that the man who attempts to construct anything without taking the advice of technical men is on a par with the lawyer who conducts his own case—and I suppose you know the rest of it—he has a fool for his client. And, being both a lawyer and Minister of Public Works, and knowing something of the consequences of not taking the best course in these matters, I have decided that, so far as I am concerned, I will rely on the advice of my technical officers on all technical questions. I quite realize that that has been the custom in the past to a great extent, and I realize that all the departments of government have their engineering officers, and, I believe, are carrying out their wishes. Perhaps I may say that, personally, I exceedingly regret the fact that, owing to the great difficulty of obtaining money, I am not able to use the services of engineers to the extent that I would like to do. I would like to be a builder, to direct operations in a big way; and I hope the day will come when my ambition may be gratified. But, under present conditions, we are not doing much, and do not intend to do very much until after this conflict is over and money is more plentiful in Canada than it is to-day. Not that there is not plenty of money. It is a peculiar fact that the country never was so rich and the government so poor as to-day. But there may be a rearrangement on this money question, and, when it comes, it will be a great pleasure to me to go on and spend the money in a businesslike way.

But the world must be very largely rebuilt, and development must be along scientific lines, which have not been followed heretofore. That brings we down to what I really want to impress upon the gentlemen present—not that I expect to give you a speech on this subject, for I realize that I do not know nearly as much about it as you do—and to impress upon every man and woman in this country, and that is the need of building up of this and every other civilized country when this great struggle is over. There are so many things around us waiting to be done, and they can only be done on proper lines, and that means on proper engineering lines. As far back as I can remember, the idea seems to have been that when a young man went into the engineering profession about the only work for him to do was on the railway survey. You see, that is all that we realized the engineer was for. And when he got through with one job he looked for another. I presume that is the experience of many men—and I see here to-day gentlemen of my acquaintance whose heads are getting as bald as my own, who have had great experience in the railway service, and I think they realize that, especially in the rural parts of our section of the country, that has been the idea of the field of usefulness for the engineer. But when the war is over we shall find that too narrow an application of engineering skill. Of course, we must have railways. I do not want to discuss the railway situation of Canada to-day, but I may go so far as to say that we are pretty well supplied with railways—at least, the Government of Canada is. Without discussing the construction of more railway, I realize that the government railways must be reconstructed. They must be safe for the trains that run over them. And this work of rebuilding is going to call for engineering ability and service. But when we have considered the railway needs we have only commenced to discuss the real engineering problems which Canada has to face. I should say that the first problem we have to face is the development of our water-powers. I may be considered a crank on this subject, but it seems to me that the experience of this country in the past three or four months because of the lack of coal must set every man thinking, even though he be the most ordinary layman in these matters, on the necessity of developing our water-powers so as to make ourselves independent of coal as far as possible, at least for power. I do not say the same applies to heat. We were having a very interesting discussion at this table during luncheon on this point. I do not believe that we have yet reached the stage of development where we can economically heat our buildings with electricity. But if all the power we use were developed electrically we could save an enormous amount of coal, sufficient to heat all our buildings. But there are applications of heat in which electricity can be used, especially in cooking. I was surprised to have your president tell me that under the ruling prices of to-day the cost of cooking for an ordinary family is $2 a month. That is away below the cost of cooking with coal. This illustrates how water-power can be used, not only for power but for heat, and in a hundred and one things necessary in the world to-day. When I look around the city of Ottawa, which really exists on account of the development of your water-power, and realize that probably not one-quarter of the available water-power within twenty miles of the city is yet developed, I sometimes wonder what could be accomplished if we had sufficient money and energy to have all these water-powers developed. I never drive up the Gatineau without thinking of the great water-powers there that are going to waste. And up the Ottawa there is the same condition. And when you come to the St. Lawrence River you have power going to waste by the million horse-power. I am not advocating any policy—I do not think it would be wise to do so, occupying the position I do—but if I might be permitted an expression of personal preference, to me there is a great deal more beauty in water-power developed and working than in water-power going over a rapid. I quite admit that I have not been trained along the aesthetic lines on which some of my neighbors have been led, and so may not sufficiently appreciate the beauties of nature. But I do appreciate the beauty of water going through a water-wheel. And I quite understand, also, that this desire cannot be brought about except by co-ordination of the training of the engineer and the capital of the man who is willing to risk money to make more money. I am not talking questions of policy, but I hope that I shall live to see the time when there will not be one rapid on the St. Lawrence, but all will be converted into water-power and making money. And what I say of the rapids of the St. Lawrence I say with regards to every waterfall on every river in the Dominion.

Manufacturers' Catalogues

Numerous trade catalogues issued by the larger American and Canadian industrial firms are so elaborate in pictorial and descriptive detail as to partake almost of a text-book character. In many technical schools these have been found to be almost a necessary adjunct to the class text-book, in fact. The Information Department, Vocational Office for Ontario, Invalided Soldiers' Commission, 185 Spadina Avenue, Toronto, desires to obtain at once literature of this character for placement where it will do most good, and this journal is glad to pass the pointer along.

The city of London, Ont., has determined to protest to the provincial legislature against the operation of the Highways Act, which empowers the County of Middlesex to compel the city to contribute money towards those roads in the vicinity of the city classed as "suburban." The London council has decided as a war measure to initiate no new construction within the city this year, in view of high taxes, and objects to spending money in the rural municipality.

Mr. James McDonald, who for sixteen years had carried on a building and contracting business in Toronto, died recently at his home in that city, in his seventy-seventh year.

Mainly Constructional

East and West—From Coast to Coast

The Cadwell Brick Company, Ltd., has been incorporated, with a capital of $200,000; headquarters at Windsor, Ont.

The bricklayers of Guelph, Ont., have demanded an increase in wages from 55 cents an hour to 62½ cents. to become effective May 1.

A plant for the manufacture of fuel from garbage is to be established in the city of Guelph, Ont., by the Guelph Oakoal Company, at a cost of some $60,000.

The Loomis-Dakin Construction Company, Ltd., has been incorporated as a joint stock company, with a capital of $50,000; headquarters at Sherbrooke. P.Q.

Work is being commenced on the new shed to be built on the government wharf at Vancouver, B.C., at a cost of about $130,000. Hodgson & King, a local contracting firm, have the contract for the structure, and will employ about 200 men on the work.

The recent floodings of the River Thames have resulted in serious damage to the city of London waterworks dam at Springbank, where a hole has been cut under the dam in the centre of the stream. The result is that the water is pouring through the opening, and the generation of power there to correct the hydro peak load in the city has been discontinued.

Additions are to be made this spring to the sanitorium at Fort Qu'Appelle, Sask., costing approximately $250.000. The present building was opened last October, and has cost $300,000 to date, but its accommodation is already taxed to capacity. The additions are to consist of a new infirmary and three new pavilions. Tenders for the new buildings will be called for shortly, and work will be commenced upon the opening up of spring.

At a recent session of the Council of the Township of Cleveland, P.Q., a resolution was passed expressing a desire to improve the roads of the township under the "Good Roads Act, 1912." and requesting the provincial government to furnish the funds necessary for that purpose, and also to take steps for the preparation of plans and specifications in connection with the Danville-Richmond-Sherbrooke highway where it passes through the limits of the municipality and is not included in any by-law already passed.

The work of completing the Bloor Street viaduct so that it may be crossed by vehicle traffic, is to be carried out as soon as possible, and negotiations are under way to procure rails for the car tracks and creosoted paving blocks. In addition, Danforth Avenue is to be paved and railed from the east end of the main viaduct to the head of Broadview. It is also proposed to pave and rail the new street in Rosedale between the two viaducts and the new street along the ravine from the head of Parliament Street to Bloor Street.

A deputation of residents of the Runnymede Road district, north of St. Clair Avenue, Toronto, appeared before the York Township Council recently to ask that the township take over the management of the water and sewage systems in the district and, if possible, improve on the present arrangements. Reeve Griffith explained that the township engineer had estimated the cost of an improved water system, such as would be needed, at $8,200, and that the taxes paid in the district would not justify the expenditure. The council will get in touch with the city works department regarding the matter of sewage disposal, but cannot consider taking over the private water supply system which now exists in the district.

Personals

Mr. H. S. Van Scoyoc, chief engineer of the Toronto-Hamilton Highway Commission, has been appointed manager of the publicity department of the Canada Cement Company, with headquarters in Montreal. Mr. Van Scoyoc has had charge of the work of the construction of an interurban concrete highway between Toronto and Hamilton—the first road of its kind in the province—where he has constructed for himself a monument of a most lasting character. During this three-and-a-half-year period he has also been author of a number of splendid papers on concrete highway construction and prominent in addressing highway organizations and other public gatherings wherever he has felt that good seed would bear fruit. As publicity agent for the Canada Cement Company his interests will still be in the same direction, and we trust his efforts will meet with as great success. Mr. Van Scoyoc has consented to give the Toronto-Hamilton Highway Commission the benefit of his wide experience in a consulting capacity until such time as the bridge work and certain other details in connection with the highway are completed.

Mr. H. S. Van Scoyoc.

Mr. James O'Hara has resigned his position as municipal engineer of Surrey, B.C.

Mr. W. B. Champ has been appointed managing director of the Hamilton Bridge Works Company, Hamilton, Ont., succeeding the late R. M. Roy.

C. C. Lapierre has rejoined the engineering staff of the publicity and promotion department of the Canada Cement Company, Ltd., from which he resigned about a year ago to open an office in Quebec as a cement engineer.

Captain W. M. Everall, A.M. Can. Soc. C.E., who has had two years' service in France, and was formerly Dominion Government engineer, Port Arthur, Ont., has been appointed assistant engineer, British Columbia Public Works Department.

William Ramsey, formerly city engineer at Fernie, B.C., and more recently assistant road superintendent for the Canadian Pacific Railway in that district, has been appointed district engineer for West Kootenay, under the provincial government.

The Vokes Hardware Company, Limited, Toronto, have purchased the entire stock of mantels, grates, and tiles of the T. Eaton Company, who are discontinuing these lines.

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Farming Contracting—A New Field and An Opportunity for Patriotism

THE world is being subjected to a devastating upheaval and it will take years for it to recover completely from the period of depression that will follow the war. It is thought by many in Canada that active and intensive development of our natural resources will greatly alleviate and shorten this period of hard times. That contracting interests are cognizant of the necessity of greater food production and, incidentally, the necessity of greater land development, is shown by the consideration they are giving to the mobilizing of contractors and engineers for this important work. An article which appeared in last week's issue of the Contract Record discusses at length the mobilization of constructional forces in Canada for greater food production. The program calls for the breaking up of 500,000 acres during the coming summer and an additional 500,000 acres in 1919, and the taking of crop from 1,000,000 acres in 1920. It is proposed to let contracts to builders and contractors to cultivate five or six or more sections of land under the supervision of agricultural experts. There is very little doubt that an agricultural country will recover more rapidly than a manufacturing country. As a direct result of the exodus of population of recent years from rural to urban districts, there is a large acreage in the West that has never been broken, and in the province of Ontario particularly, where intensive cultivation owes every promise of success, the mode of farming has scarcely been given a trial.

To harvest 500,000 acres and plant 1,000,000 acres of virgin soil in two summers is an enormous undertaking and would be an utter impossibility under present labor conditions, were it not that mechanical devices for doing work have been perfected and will be used far more extensively than has hitherto been the case. Labor shortage and the consequent demand for agricultural products has accelerated the development and production of farming appliances, of which the tractor, whether driven by steam or internal combustion engines, is of paramount importance. The question as to whether a universal machine adapted to working on the land, to stationary work and to road haulage work, is better than special machines for each department, has been a matter of much speculation. The motor-driven tractor, with wide tractor wheels, equipped with 30 to 35 h.p. engines is a very popular machine for farmers having one to two hundred acres under crop, but where wholesale farming is the practice it is thought that steam-driven tractors using straw and other vegetable matter for fuel and capable of handling 20 or 30 disks when ploughing, would be the most economical.

There is a likelihood that munition contracts will be considerably cut down in the near future, placing on the labor market a large number of skilled machinists who would be particularly fitted to operate tractors and machines used for cultivating the land. The efficiency of this labor would be sadly handicapped if these workmen were compelled to devote their energies to ordinary farm labor, instead of along lines in which they have had considerable training.

Further, a general contractor or construction engineer is well fitted to organize this work, since he very often has had to carry out a piece of engineering under difficulties within an allotted time and is schooled to cope with varied contingencies and direct his forces to gain the best results. It may be that ploughing could be carried on for twenty-four hours instead of ten hours per day, by fixing headlights to the tractors and working two twelve-hour or three eight-hour shifts.

This project is worthy of deep consideration by the contractors of Canada and by the Dominion Government. The conscription of labor for planting and harvesting the crop has been a matter of much discussion, the government being more or less opposed to taking such drastic steps. It looks as though letting contracts for harvesting as well as for breaking in new land would be a quite reasonable policy.

Get Back to the Land!

AT a meeting of the Exchange on March 19th, Mr. J. P. Anglin, President of the Montreal Builders' Exchange, elaborated the plan for the cultivation of idle land. He pointed out that the country had the land, the contractors the organization; men were available, and profits were assured, though in regard to the latter Mr. Anglin took the stand that this was secondary. There was plenty of available machinery, and even the question of getting sufficient tractors could be solved. As to labor this seemed at first a point of difficulty, but contractors knew well that labor could be secured. Where something was going on, there was always labor. Another fact in the labor problem was that munition plants were slackening up and many mechaics who knew how to run machinery would be available to run machines on farms. He pointed out that machinery would work in shifts, night and day, the business being run as contractors run the business of getting through an ordinary contract within a specified time. Moreover, Mr. Anglin said, not many men would be required, and the most that could be used this year was 3,000, a mere drop in the labor bucket.

A resolution endorsing the idea was passed, and the Minister of Agriculture is to be asked to take immediate action.

Contractors' Production Scheme is Commended by Special Committee

THE agricultural committee appointed by the chairman of the Canada Food Board, Mr. H. B. Thomson, to report on the proposal to utilize contractors and their organizations for developing tracts of idle land for food production, has made its report. The findings are signed as follows: Mr. W. J. Black, commissioner, Department of Agriculture, Ottawa; Mr. J. N. Grisdale, director, Dominion Experimental Farms; Mr. H. O. Wright, M.P., Battleford; Prof. James Murray, Macdonald Agricultural College; Mr. A. Leitch, manager, Ontario Agricultural College Experimental Farm; Mr. C. F. Bailey, Assistant Deputy Minister of Agriculture for Ontario; and Mr. George S. Henry, M.L.A The conclusions of the committee are as follows:

1. That immediate action be taken to utilize this great semi-latent force of contractors to organize the non-productive labor of Canada to speed up the work of food production on idle lands. Idle organizations, plus idle labor, plus idle land.

2. That in the East the first operations be on idle land adjacent to or within the municipalities of Montreal and Toronto, and that the work here be conducted as an experiment with the view to: (a) Inducing a class not engaged in agriculture to turn their attention to the land; and (b) demonstrating to the people generally the fact that agricultural production is the great need of the day.

3. That the operations in the West be on a comprehensive scale, and include as much suitable land as it is found possible to group conveniently for economical management.

4. That the construction organizations of Canada provide the forces to carry out the work under the expert direction of the best agricultural men of Canada, and that every effort be made for maximum crops in 1919, 1920, and 1921.

No Labor from Farms

5 That the co-operation of the Soldiers' Settlement Board be secured.

6. That, as this plan is based on using the less productive and idle labor under organized direction, no person should be employed who was engaged in food production in 1917, unless it can be shown that his services are essential to this great project, and that no labor be taken from existing farms. This committee is of the opinion that this idle land cultivation movement would result in a considerable number of men permanently settling on the land, and it is also probable that in securing labor for this project much labor could be diverted to existing farms.

7. That plans be made and the organization prepared to increase its operations on the cessation of hostilitieis when the most idle labor will be available, and when, undoubtedly, the greatest scarcity of food will exist, both here and abroad.

8. That we believe the urgent need for increasing food production is such that the government, through the Canada Food Board, should give the project its technical and financial support.

9. That, in view of the shortness of the time left to prepare for commencing operations, immediate action is imperative.

Toronto Builders' Exchange Meets

THE first meeting of the Toronto Builders' Exchange in their new quarters, 34 Victoria Street, was held on Wednesday, March 13, with President W. E. Dillon in the chair. No business was transacted. Mr. Walter Davidson, on behalf of the members, presented the retiring president, Mr. S. R. Hughes, with a beautiful club bag in appreciation of his efficient services. Mr. John Aldridge presented a mahogany humidor filled with a good brand of cigars, also a framed Life Membership Certificate in the Exchange, to Mr. Wm. Forbes, of the firm of Ford and Forbes. Mr. Forbes, who is 78 years old, has been in the contracting business for 52 years and a member of the Exchange for 51 years, having been a charter member of the Toronto Builders' and Supply Association, which later was formed into the Builders' Exchange of Toronto. Mr. Forbes is the only member to enjoy the distinction of a Life Membership.

Several speeches of a reminiscent nature followed the presentations. Among the speakers were W. J. Hill, Registrar of York County; John Poucher; John Wickett; James Munro; Wm. Hughes; Geo. Gander; Henry Taylor; Capt. McFarren; George Stocker; Henry Jennings, and Charles Bulley.

Mineral Production in Canada

MINERAL production of Canada has materially increased in value, although not in quantity, during the year 1917. The value of the last year's production shows an 8.9 per cent. increase over the values of 1916, amounting to $15,781,303. Two-thirds of this increase is directly attributed to coal, gypsum, and cement, though the quantities marketed, of these minerals, were less than in the previous year. This falling-off in the production of coal has a diminishing effect on the metallurgical production, the reduced production of copper and gold being in part attributable to this cause. Details of the report on the mineral production appear in this issue, which shows there has been an increase in output of zinc, cobalt, molybdenite, and nickel.

New Sales Office

MacKinnon, Holmes & Co., Ltd., of Sherbrooke, Que., have opened a sales office at 404 New Birks Building, Montreal, Que., Mr. W. J. Lochhead being in charge.

Flat Slab Codes Compared with Tests Carried Out on Toronto Buildings—II.

Submitted by the City Architect's Department—Present Article Deals with Robert Simpson Building—For previous Article See Contract Record, Oct. 17, 1917

Toronto, March 23, 1918

Editor, Contract Record:—

I beg to hand you herewith results of tests on the building of the Robert Simpson Company, compared with flat slab codes of different municipalities; also an article contributed by Professor Gillespie of the University of Toronto.

At the time the tests were made Professor Gillespie kindly consented to help this department in conducting a test which would prove whether the building was strong enough to carry the loads for which it was designed, and it was also thought that the tests would give additional information to this department, so that we would be in a position to draft an up-to-date by-law covering flat slab type of construction.

Due to the cracks around the column capital it was necessary, as shown in Fig. 6, to break the panel into strips, finding the moment of inertia of each strip, and then adding them together. This, of course, would only give at best a very rough approximation, and, therefore, in considering these tests, due consideration must be given to this. I might draw your attention to the stresses given on Fig. 3-4, where it will be noticed in a great many cases that when the load is removed entirely there still seems to be a larger stress in the steel and concrete than what was given by the first load of 135 pounds. This is shown in tables of stresses under columns 1 and 4. The only explanation I can give for this is that concrete has not the elastic nature that steel has, but is more plastic, and, therefore, when the load is applied to concrete, the concrete in compression is crushed and does not spring back to its original position. Another reason, no doubt, is due to the fact that when the second load of 270 pounds was applied, bad cracks developed around the column capital head, thereby weakening the resisting value of the concrete in tension, so that even when the loads were removed the original dead load would cause considerable stress in the steel and concrete due to damaged condition of the concrete; therefore, when the final extensometer readings are taken the set of the concrete will be read by the instrument.

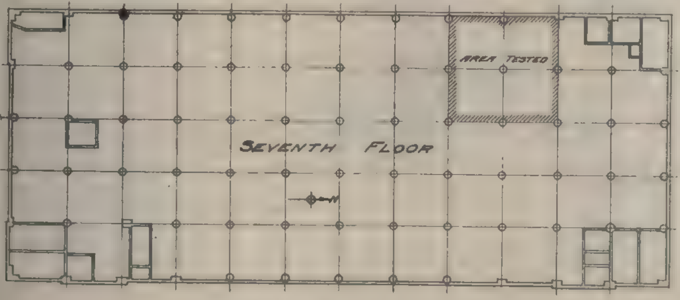


FIG. 1.
KEY PLAN.

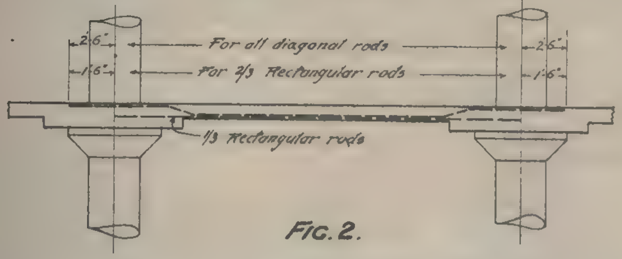


FIG. 2.

The deep cracks around the column heads are due to the steel work being set too low below the top of concrete. It will be noted by referring to Fig. 3, Col. 23, that the average distance below the top of the concrete to the steel is about 3½ in. It is evident, therefore, that as soon as there is any tensile stress in the steel that there must be considerable tensile stress in the outside fibres of the concrete, and as this is only good for about 350 pounds to the square inch it would soon crack. From this test it would seem to the writer that either Chicago or Philadelphia codes, or the report of the joint committee would give very safe and satisfactory results.

Professor Gillespie was assisted by Mr. R. J. Fuller and Mr. T. D. Mylrea, who were in the employ of this department at the time the tests were made, and Mr. W. A. McM. Cook, of this department, assisted in compiling the results as given herewith.

Yours very truly,
W. W. Pearse,
City Architect and Superintendent of Building.

The Question of Unbalanced Thrust

By Peter Gillespie, M. Can. Soc. C. E.

No other type of reinforced concrete construction has appealed to the building public or has caught the popular fancy as has that commonly described as the flat slab or girderless floor. The resulting economy in storey heights, the simplified form construction, the unbroken ceilings, and the ease with which auxiliary equipment, as, for example, sprinkler systems can be installed, have all contributed to that popularity. But, while these advantages have been generally recognized, the difficulties attending the rational design of flat slab structures have also been appreciated, because this type does not lend itself to either simple or satisfactory theoretical treatment. Recognizing this, public-spirited firms and organizations have provided facilities whereby tests of full-size buildings have been made wih a view to studying the behavior of floors under loads, and thereby formulating empirical rules for the design of flat slabs which, when constructed, would be safe without being wasteful. These tests have usually consisted in applying to the floor a live load equal to or exceeding that for which the structure was built and then measuring the deflections and the deformations in the steel and concrete at certain selected places in order to determine the intensity of the stress resulting. From the nature of the work some form of portable extensometer was necessary, and for

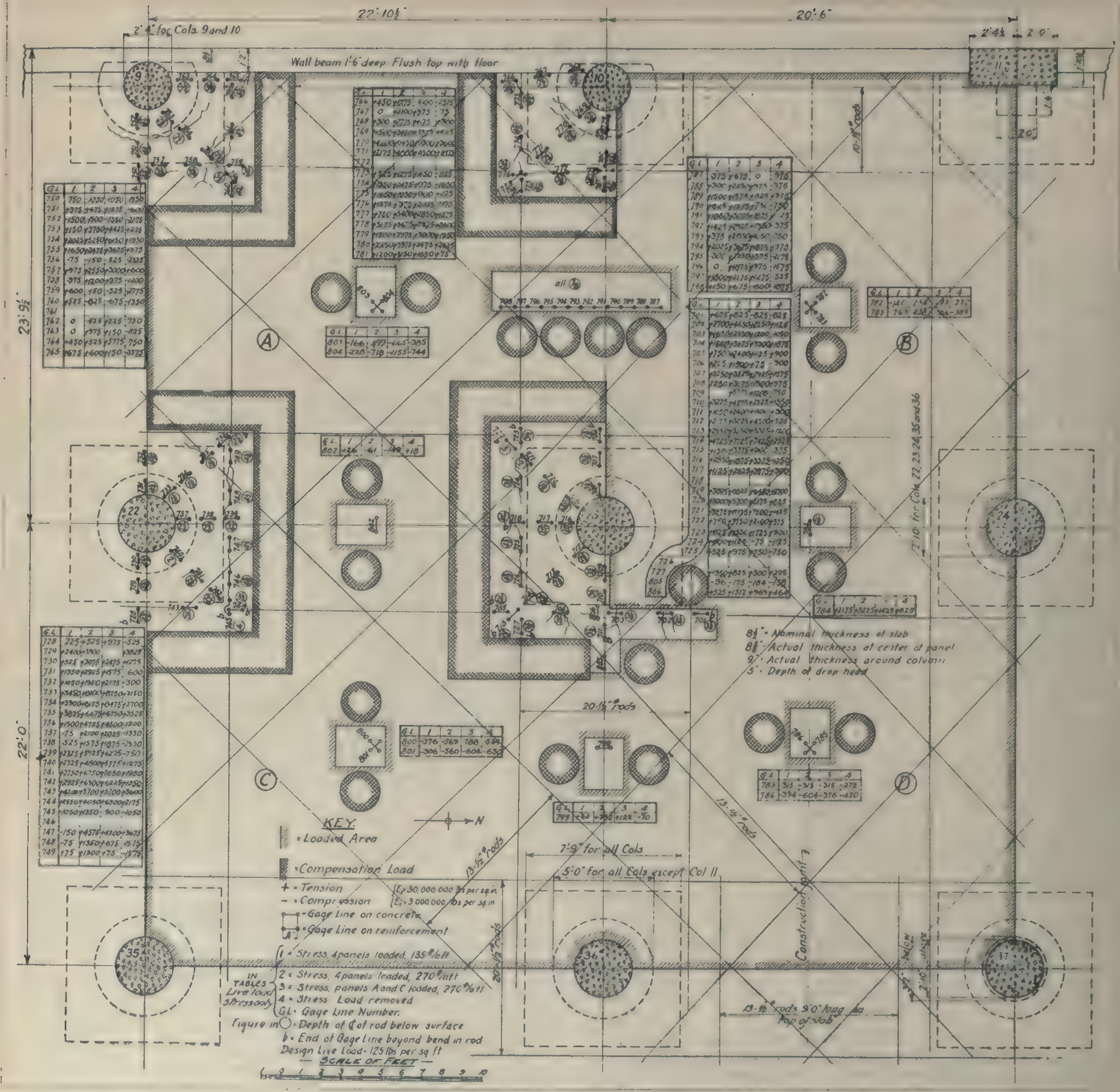

22'-10½"
20'-6"
2'-4" for Cols 9 and 10
2'-4½
2'-9"
Wall beam 1'-6" deep Flush top with floor
23'-9½"
22'-0"
10-⅝" rods
7'-10" for Cols 22, 23, 24, 35 and 36
all ①
A
B
C
D
9
10
11
22
24
35
36
37
20-½" rods
13-½" rods
20-½" rods
7'-9" for all Cols
5'-0" for all Cols except Col 11
Construction joint
13-½" rods 9'-0" long at top of slab
8½" = Nominal thickness of slab
8⅝" = Actual thickness at center of panel
9" = Actual thickness around column
5" = Depth of drop head
KEY
= Loaded Area
= Compensation Load
+ = Tension
− = Compression
Eₛ = 30,000,000 lbs per sq in
E꜀ = 3,000,000 lbs per sq in
= Gage Line on concrete
= Gage Line on reinforcement
IN TABLES Live load Stresses only
1 = Stress, 4 panels loaded, 135#/a ft
2 = Stress, 4 panels loaded, 270#/a ft
3 = Stress, panels A and C loaded, 270#/a ft
4 = Stress, Load removed
GL = Gage Line Number.
Figure in ○ = Depth of ℄ of rod below surface
b = End of Gage Line beyond bend in rod
Design Live Load = 125 lbs per sq ft
— SCALE OF FEET —
0 1 2 3 4 5 6 7 8 9 10
N
GL 1 2 3 4
800 -376 -569 788 -534
801 -306 -560 -604 -630
784 +2175 +5225 +4425 +6250

Fig. 3—Plan of seventh floor.

this that known as the Berry strain gauge or some modification of it, has generally been used.

Any type of extensometer which has to be attached to a specimen and removed again between readings cannot possess the accuracy of measurement usually obtained from the stationary forms. Then, again, concrete is a material for which the ratio of stress to deformation is much more variable than it is for the metals. Moreover, for any given concrete and for all stresses above moderate working values, Hooke's law of proportionality between stress and strain does not obtain. Further, it is usually quite impossible to know at just what stage of the operation of loading the concrete in tension will crack and throw upon the reinforcement the bulk, if not all, the tension which it had been carrying. In consequence of these limitations it will be conceded that the figures obtained from the use of the portable extensometer, especially on concrete structures, must be interpreted in a broad and liberal manner, and that they must not be considered as reflecting the last refinement of physical measurement. It should be noted, too, that the inevitable errors are probably relatively greater for small deformations than for large, since the ratio of probable error to a large deformation is less than to a small one.

With respect to the Simpson building test, there is one point to which attention might be called, because it relates to a phenomenon which has been observed in several previous tests, and is one which concerns the values to be assigned for the working stresses in both materials. To illustrate, Fig. 10 has been prepared from the test data. It will be seen that the various values of the observed deformations for the several gauge lines lying diagonally in one direction from column 23 have been plotted with respect to a horizontal axis, elongations upward and shortenings downward. Whether these relate to steel or concrete does not concern us, since it is to only one position on this radial line that attention is invited. Generally speaking, when either line crosses the horizontal axis, it denotes a point of zero deformation, and, therefore, a point of zero flexural stress and of zero bending moment. If both lines cross the zero axes at the same point it denotes a true point of contraflexure, at which the stresses are mainly shears. In Fig. 10, however, this is not the case, and for some distance outward from gauge line 715 the slab appears to be altogether in compression, and at gauge line 610 this, according to the records, is equal to an average stress of 70 pounds per square inch, with a resultant acting much nearer the lower face than the upper. Moreover, in this particular region the situation is not complicated by the presence of three or four superimposed layers of metal such as are found in some other places. This phenomenon is probably due to the partial behavior of the slab as an arch, an hypothesis, indeed, for which there is considerable warrant, since the peculiarity has been observed and reported on several occasions.

The City Architect of Toronto, Mr. W. W. Pearse, is to be commended on the way in which he has planned these investigations and on the amount of profitable study which he has devoted to this problem of construction. All of the doubtful points have not been cleared up as yet, although much light has been thrown on many of them. As a result of careful and patient work by many investigators the design of flat slab structures is to-day on a much more intelligent basis than it was five years ago.

Results of Test on the Robert Simpson Building Compared with Flat Slab Codes

By W. W. Pearse, C. E.

THE method of construction used in this building is the four-way flat slab drop head reinforced concrete system known as "the four-way system." Fig. 1 is a general plan of the building showing the area tested.

Figs. 2, 3 and 4 show the arrangement of the reinforce-

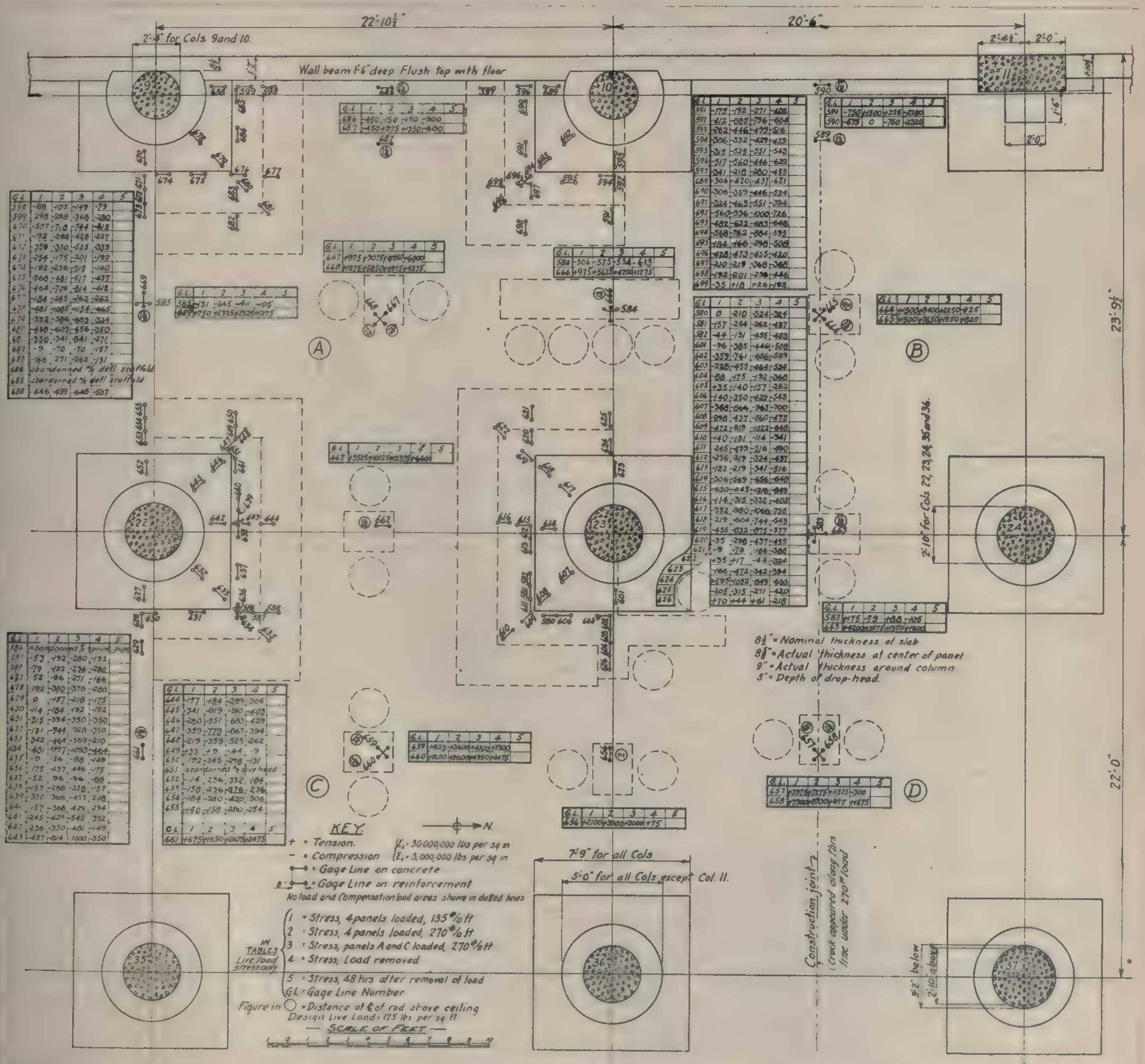

22'-10½"
20'-6"
2'-4" for Cols 9 and 10.
2'-4½"
2'-0"
Wall beam 1'-6" deep Flush top with floor
23'-9½"
22'-0"
2'-10" for Cols 22, 23, 24, 35 and 36.
7'-9" for all Cols
5'-0" for all Cols except Col. 11.
A
B
C
D
9
10
11
22
23
24
35
36
37
8½" = Nominal thickness of slab
8⅞" = Actual thickness at center of panel
9" = Actual thickness around column
5" = Depth of drop-head.
Construction joint
Crack appeared along this line under 270# load
below
2'-10 above
KEY
+ = Tension.
− = Compression
E_s = 30,000,000 lbs per sq in
E_c = 3,000,000 lbs per sq in
Gage Line on concrete
Gage Line on reinforcement
No load and Compensation load areas shown in dotted lines
N.
IN TABLES Live load STRESSES
1 = Stress, 4 panels loaded, 135#/□ft
2 = Stress, 4 panels loaded, 270#/□ft
3 = Stress, panels A and C loaded, 270#/□ft
4 = Stress, Load removed
5 = Stress, 48 hrs after removal of load
GL = Gage Line Number
Figure in ○ = Distance of ℄ of rod above ceiling
Design Live Load: 125 lbs per sq ft
SCALE OF FEET
abandoned % defl scaffold

Fig. 4—Plan of sixth floor ceiling.

ment, and the location of the points where the readings were taken and the stresses obtained.

The readings for a live load of 135 lbs. per sq. ft. will be considered.

In comparing the stresses found by extensometer tests and those computed in accordance with the various building regulations the following notation will be used:

L = distance centre to centre of columns in feet.

w = Total live and dead load per sq. ft. = 135 + 113 = 248 lbs.

W = Total panel load in lbs. = wL^2.

S = Tensile stress per sq. in. in steel.

Ct = Extreme fibre tensile stress per sq. in. in concrete.

C = Extreme fibre compressive stress per sq. in. in concrete.

I = Moment of inertia.

Qt = Section modulus for side in tension.

Qc = Section modulus for side in compression.

Es = Modulus of elasticity of steel = 30,000,000.

Ec = Modulus of elasticity of concrete in compression = 3,500,000.

Et = Modulus of elasticity of concrete in tension = 2,800,000 (assumed as 8Ec/10 same as used for Wm. Davies Company Building).

Fig. 5 shows the strips into which the slab is considered to be divided for purposes of calculation.

Strip A at Edge of Capital

The stresses in strip A at the edge of the column capital will be considered first. The width of strip A will be taken as L/2 as assumed in the Chicago Code and Joint Committee Report.

In Fig. 6 the neutral axis, as obtained from deformations, has been plotted for readings Nos. 710, 713, 717, 601, 607 and 614, and its average position was found to be 9¼ in. from the top of the slab as indicated.

In order to arrive at a rational method for determining the section moduli of the section, making due allowance for tension in the concrete, it was assumed that the tensile strength of concrete is 1/12th of its compressive strength (see "Materials of Construction," 4th edition, by J. B. Johnson, p. 604d) and thence was found the maximum deformation which could occur in the concrete without the formation of cracks.

The ultimate compressive strength of the concrete was found by test to be 3900 pounds per sq. in. Hence the ultimate tensile strength would be 3900/12 pounds per sq. in. = 325 pounds per sq. in. and the corresponding deformation reading for live load,

$$325 \times \frac{40,000}{2,800,000} \times \frac{135}{248} = 2.5$$ (See note at foot of Table 4).

taking Et = 8Ec/10 = 2,800,000 for the concrete used.

The points in the cross-section at which this deformation occurred have been plotted in Fig. 6 and the concrete below the same was considered as effective cross-section in computing the moment of inertia and section moduli of the section. The upper inclined line in the figure marks the upper limit of this effective cross-section and the lower inclined line is drawn through the points obtained for the neutral axis for the three sets of readings mentioned above. The effective section of concrete was divided into five rectangles, a, b, c, d and e. Figs. 6a, 6b, 6c, 6d and 6e show these rectangles with the positions of their respective neutral axes as obtained from Fig. 6.

The steel has been considered as replaced by its equivalent area of concrete assuming the moduli of elasticity of steel and concrete in tension to be 30,000,000 and 2,800,000 respectively. The moment of inertia of each rectangle and its proportionate area of steel was obtained and the results added to obtain the total moment of inertia for the section. Using the average position of the neutral axis as 9¼ in. from the top of slab the section moduli were then determined.

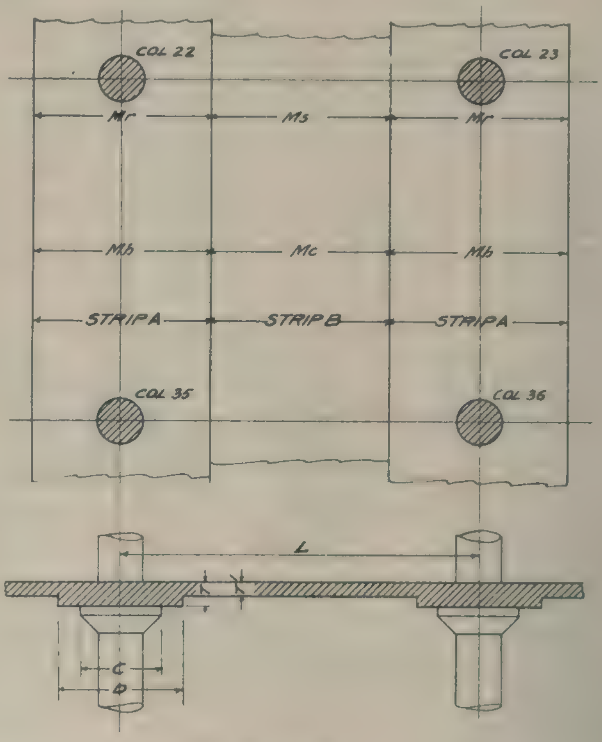


Fig. 5.

The results are as follows:—

I = 14906

Qc = 3140

Qt = 1612

According to Chicago Code,

$$Mr = \frac{WL}{30} = \frac{125,000 \times 22.43 \times 12}{30} = 1,120,000 \text{ inch lbs.}$$

$$\text{Therefore, } C = \frac{Mr}{Qc} = -\frac{1,120,000}{3140} = -357 \text{ lbs. per sq. in.}$$

$$\text{and } Ct = \frac{Mr}{Qt} = \frac{1,120,000}{1612} = 695 \text{ lbs. per sq. in.}$$

The average of readings 601, 607, and 614 is — 257 for

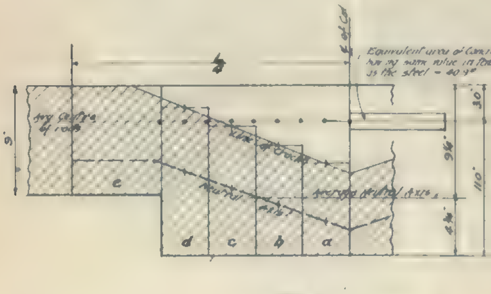


Fig. 6
al or hal section 7453

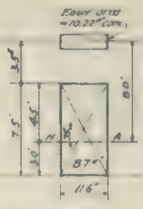


Fig. 6a
I - 1111

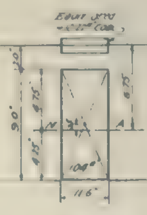


Fig. 6b
I 1177

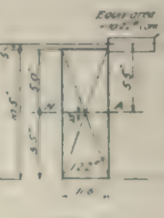


Fig. 6c
I — 1452

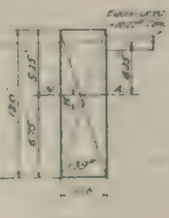


Fig. 6d
I = 1933

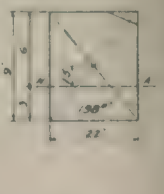


Fig. 6e
I 1780

live load only, which corresponds to a stress of — 257 × 248/135 = — 476 pounds per sq. in. for live and dead load combined. This is somewhat greater than the value for C computed above.

Using the extreme fibre stress Ct = 695 pounds per sq. in. in the concrete as found above, the computed stress in the steel is found to be 5020 pounds per sq. in.

The average of readings 710, 713, and 717 is 2300 for live load only, which corresponds to a stress of 2300 × 248/135 = 4230 for live and dead load combined, which agrees very well with that computed.

The Philadelphia Code gives the bending moment as WL/28.4 (WL/47 for the steel in the straight band, and WL/72 for the steel in the diagonal band).

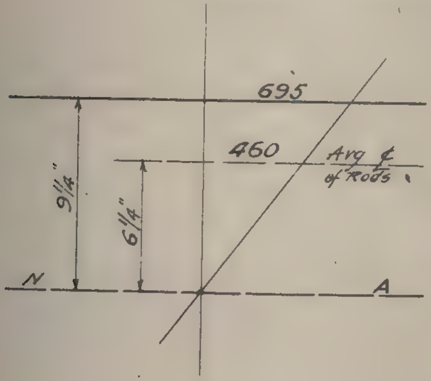


Fig. 7.

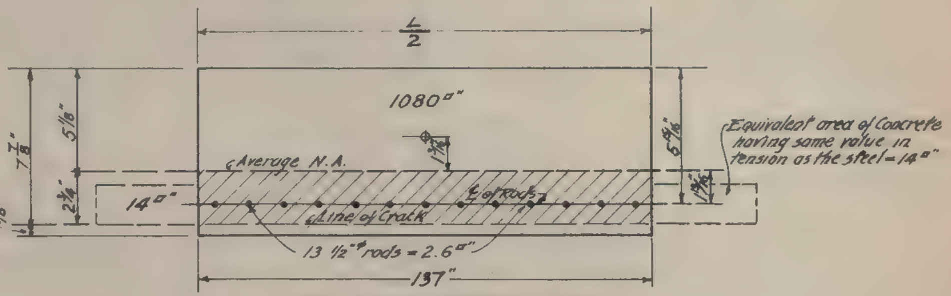


Fig. 8—I 7195, Qt 2620, Qc 1410

The Joint Committee Report gives the moment as WL/25.

The stresses computed by these moments for the readings mentioned above are given in Table 3. It will be noted that the distribution of steel at the column capital in the straight and diagonal bands differs considerably from that required by the Philadelphia Code, so that the table shows a high stress for the steel in the straight band, and a comparatively low stress for the steel in the diagonal band at this point in the computation by the Philadelphia Code.

To find the moment coefficient which corresponds to the stresses computed from deformations given by test we may equate the bending moment to the resisting moment thus:—WL/x = Qt.Ct and WL/x′ = Qc.C where x and x′ are the coefficients to be determined.

The average unit stress in the steel for total load as found above from readings 710, 713 and 717 was 4230 pounds per sq. in.

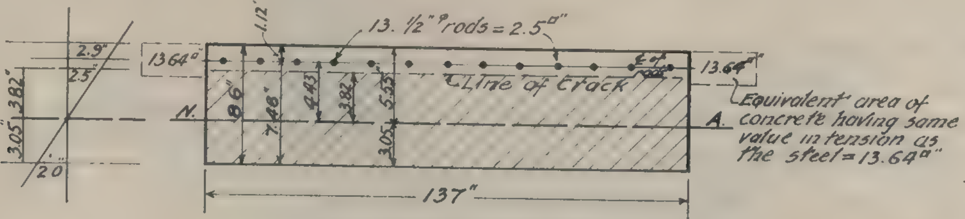


Fig. 9—I 4102, Qc 1346, Qt 876

This corresponds to an extreme fibre stress in the concrete of

$$4230 \times \frac{2,800,000}{30,000,000} \times \frac{9\frac{1}{4}}{6\frac{1}{4}} = 584 \text{ lbs. per sq. in.}$$

$$\text{Therefore, } \frac{125,000 \times 22.43 \times 12}{x} = 1612 \times 584,$$

whence x = 36.

The average extreme fibre stress in the concrete for total load as found above was — 476.

$$\text{Therefore, } \frac{125,000 \times 22.43 \times 12}{x'} = 3140 \times 476,$$

whence x′ = 22.6.

The average of x and x′ = 29.3 or roughly 30.

Therefore, the moment as found from test is WL/30, which agrees with the Chicago By-law and also very closely with the Philadelphia By-law.

Strip B at Centre of Panel

In Fig. 8 the position of the neutral axis has been determined as before from deformation readings 800, 801, 659 and 660, the average of readings 800 and 801 being 3.9 and the average of readings 659 and 660 being 1.35.

The width of strip B has been taken as L/2 and the area of steel assumed according to the Chicago By-law.

Using the greater of the deformations found for the reinforcement, viz., 1.6, it is found that the concrete below a point about ⅝ in. from the lower surface is over-stressed in tension. Therefore, only the concrete above this point has been considered as effective cross-section in computing the moment of inertia and section moduli of the section which follow:—

$$I = 7195 \qquad Qt = 2620 \qquad Qc = 1410$$

According to Chicago By-law Mc = WL/120 = 280,000 in. pounds.

$$\text{Therefore, } Ct = \frac{280,000}{2620} = 106,$$

$$\text{and } C = \frac{280,000}{1410} = 200.$$

Using the extreme fibre stress of 106 pounds per sq. in. in the concrete the computed stress in the steel is

$$106 \times \frac{1\ 13/16}{2\frac{3}{4}} \times \frac{30,000,000}{2,800,000} = 750 \text{ lbs. per sq. in.}$$

The average live load stress found from readings 659 and 660 is 1012 pounds per sq. in., which corresponds to a total stress of 1012 × 246/135 = 1847 pounds per sq. in. or more than twice that found by using the Chicago Code, taking into consideration tension in the concrete.

The average live load stress found from readings 800 and 801 is 341 pounds per sq. in., which corresponds to a total stress of 341 × 246/135 = 622 pounds per sq. in. in compression in extreme fibre of concrete, or more than three times that found by Chicago Code, taking into consideration the tension in the concrete.

TABLE 1. Comparison of Recommendations of Chicago and Philadelphia Codes and Joint Committee Report.

Code	Strip A	Strip B	Mr	Mb	Ms	Mc	C†	D†	T†	T′†
Chicago	$\frac{L}{2}$	$\frac{L}{2}$	$-\frac{WL}{30}$	$+\frac{WL}{80}$	$-\frac{WL}{120}$	$+\frac{WL}{120}$	.225L	.33L		6″ or $\frac{L}{32}$
Philadelphia	$\frac{45}{100}L$	$\frac{45}{100}L$	$-\frac{WL^{*}}{289}$	$+\frac{WL}{94}$	$-\frac{WL}{155}$	$+\frac{WL}{149}$	.2L	.38L	$1\frac{2}{3}T'$	
Joint Comm^te	$\frac{L}{2}$	$\frac{L}{2}$	$-\frac{WL}{25}$	$+\frac{WL}{55.5}$	$-\frac{WL}{100}$	$+\frac{WL}{133}$	.2L	.4L		6″ or $\frac{L}{32}$

**Mr for steel in straight band is $\frac{WL}{44}$ and for steel in diagonal band $\frac{WL}{72}$.*
†C.D,T,T′, are minimum dimensions allowed by Codes.

The stresses computed by the other By-laws are given in Table 3.

To find the bending moment which corresponds to the stresses ascertained by tests we have as before:—

$WL/x = Qt.Ct$ and $WL/x' = Qc.C$ where x and x′ are the required coefficients.

The unit stress in the steel for the total load was 1847 pounds per sq. in. as found above.

TABLE 2. Comparison of Stresses for Live & Dead Loads combined, according to various Codes with those found by Test. Stresses are in Pounds per Square inch

	At edge of Capital						Strip A at Centre			Strip B at Centre								Strip B at ℄ of Cols	
Reading No.	710	713	717	601	607	614	656	662	663	657	658	659	660	785	786	800	801	784	583
Stress in	Steel	Steel	Steel	Conc.	Conc.	Conc.	Steel	Steel	Steel	Steel	Steel	Steel	Steel	Conc.	Conc.	Conc.	Conc.	Steel	Conc.
Chicago Code	15900	15040	15570	-658	-592	-635	18000	16080	16080	17880	16350	16350	17880	-326	-390	-326	-390	13270	-357
Philadelphia Code	30600 Str. Band 10000 Dia. Band	28800 Str. Band 9400 Dia. Band	29800 Str. Band 9710 Dia. Band	-695	-626	-671	15310	13690	13690	14890	13610	13610	14890	-302	-361	-302	-361	10270	-307
Joint Comm^te Report	19600	18450	19100	-789	-710	-762	25950	23160	23160	11510	10530	10530	11500	-294	-352	-294	-352	15900	-428
Test	5925	4680	2066	-176	-676	-562	3860	6480	7720	7240	7110	1504	2190	-574	-717	-685	-557	3960	-319

This corresponds to a stress in the concrete at 2¾ in. below the neutral axis of

$$1847 \times \frac{2,800,000}{30,000,000} \times \frac{2\frac{3}{4}}{1\ 13/16} = 262,$$

$$\text{Therefore}\ \frac{125,000 \times 22.43 \times 12}{x} = 2620 \times 262$$

whence x = 49 or Mc = WL/49.

Considering now the stress in the concrete which was 622 pounds per sq. in. for total load we have

$$\frac{125,000 \times 22.43 \times 12}{x'} = 1410 \times 622$$

whence we find x′ = 38.4 or Mc = WL/38.4.

Taking the average of these two results we have a moment of ½ (WL/49 + WL/38.4) = WL/44 for strip B at centre.

TABLE 3. Comparison of Stresses for Live & Dead Loads combined according to various Codes with those found by Test using the Section Modulus determined by deformation readings

	Strip A at edge of Capital		Strip A at center	Strip B at centre				Strip B at ℄ of Cols	
Reading No.	710, 713, 717	601, 607, 614	656	657-8	659-60	785-6	800-1	784	583
Stress in	Steel	Concrete	Steel	Steel	Steel	Conc.	Conc.	Steel	Conc.
Chicago Code	5020	-357	855	750	750	-200	-200	2890	-176
Philadelphia Code	5300	-377	727	900	900	-185	-185	2240	-151
Joint Comm^te Report	6150	-428	1231	483	483	-180	-180	3460	-210
Test	4230	-476	3860	7175	1847	-645	-622	3960	-319

Strip B at Centre Line of Column

Fig. 9 shows a cross-section through strip B at the

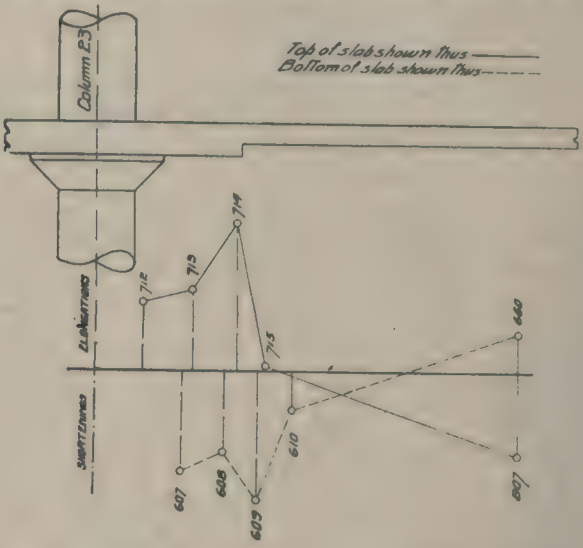


Fig. 10.—Deformations in steel and concrete graphically shown.

centre line of columns, indicating the position of the neutral axis as determined from deformation readings.

It was found in the same manner as before that a deformation of 2.5 for the live load would occur at 3.82 in. above the neutral axis, so that only the concrete below this point could be considered effective. The properties of the section determined on this basis are:—

I = 4102
Qc = 1346
Qt = 876.

The bending moment according to Chicago By-law is 236,000 in. pounds.

$$\text{Therefore, } C = \frac{236,000}{1346} = 175\tfrac{1}{2} \text{ lbs. per sq. in.}$$

$$Ct = \frac{236,000}{876} = 270$$

$$\text{and } S = 270 \times \frac{30{,}000{,}000}{2{,}800{,}000} = 2{,}890 \text{ lbs. per sq. in.}$$

Readings 583 and 784 give C = 319 and S = 3960 as the stresses for total load.

To find the bending moment coefficient corresponding to these readings we have

$$\frac{111{,}000 \times 21\tfrac{1}{4} \times 12}{x} = 876 \times 3960 \times \frac{2{,}800{,}000}{30{,}000{,}000}$$

whence x = 88,

— TABLE 4. —

EXTENSOMETER READINGS OF DEFORMATIONS CAUSED BY LIVE LOADS.

Gage Line	135# on 4 panels	270# on 4 panels	270# on 2 panels	Load Removed	Gage Line	135# on 4 panels	270# on 4 panels	270# on 2 panels	Load Removed
580	±0.0	-2.4	-3.7	-3.7	650	-2.2	-2.8	-3.4	-1.5
581	-1.8	-2.9	-3.0	-5.0	651				
582	-0.5	-1.5	-5.2	-4.6	652	-1.3	-2.7	-3.8	-2.1
583	+2.0	-0.9	+1.0	-1.2	653	-1.8	-2.7	-4.3	-2.7
584	-3.5	-6.0	-6.1	-7.0	654	-2.1	-3.2	-4.8	-3.5
585	-1.5	-2.8	-4.7	-1.2	655	-1.6	-1.8	-3.2	-2.9
586	Cancelled— — —			— —	656	+2.8	+5.2	+4.0	+0.1
587	-0.6	-2.2	-3.2	-2.2	657	+5.3	+9.7	+15.1	-0.4
588	-0.9	-1.4	-2.7	-3.2	658	+5.2	+11.6	+1.3	+2.1
589	-1.0	+2.0	+0.3	-3.0	659	+1.1	+4.8	+5.6	+4.4
590	-0.9	0.0	-1.0	-3.1	660	+1.6	+4.8	+6.6	+3.3
591	-2.0	-2.2	-3.1	-4.6	661	+0.9	+2.2	+3.3	+3.3
592	-4.7	-10.4	-9.1	-6.9	662	+4.7	+13.5	+16.5	+8.8
593	-3.0	-5.1	-3.7	-5.9	663	+3.6	+18.1	+1.8	+1.6
594	-3.5	-3.8	-4.9	-4.9	664	+2.0	+11.2	+3.0	-1.5
595	-3.6	-6.0	-6.3	-6.2	665	+2.0	+10.2	+2.6	+1.1
596	-5.9	-6.4	-5.1	-7.1	666	+1.3	+7.5	+5.6	+1.7
597	-3.9	-2.5	-3.2	-5.2	667	+1.3	+12.1	+13.8	+8.0
598	-1.0	-1.2	-1.7	-0.9	668	+1.7	+7.8	+9.3	+5.7
599	-3.4	-3.4	-4.2	-3.2	669	+1.0	+3.1	+3.1	+1.7
600					670	-3.8	-8.2	-8.5	-7.0
601	-1.1	-4.4	-5.1	-5.8	671	-2.2	-3.0	-4.9	-2.6
602	-4.1	-8.7	-7.5	-6.5	672	-4.1	-4.0	-6.0	-4.1
603	-2.6	-5.2	-5.3	-6.1	673	-2.9	-2.0	-2.3	-2.2
604	-1.0	-2.0	-2.2	-4.2	674	-2.2	-2.7	-3.6	-1.6
605	+0.4	-1.6	-1.8	-3.0	675	-4.2	-5.5	-5.9	-5.0
606	-1.6	-4.0	-4.9	-6.2	676	-5.3	-8.1	-9.3	-4.7
607	-4.2	-9.9	-11.0	-8.0	677	-2.1	-2.8	-3.0	-3.0
608	-3.4	-5.0	-6.4	-5.4	678	-5.5	-12.4	-13.2	-7.6
609	-5.4	-10.5	-11.7	-7.4	679	-3.8	-6.7	-7.8	-3.7
610	-1.6	-1.5	-1.3	-3.9	680	-5.0	-6.9	-7.5	-4.0
611	-2.8	-5.7	-5.9	-5.6	681	-4.0	-3.9	-3.9	-3.1
612	-2.7	-2.5	-3.7	-5.0	682	-0.1	-0.8	-0.8	-1.8
613	-1.4	-2.5	-3.9	-5.9	683	-1.9	-3.1	-3.0	-1.5
614	-3.5	-6.5	-7.5	-7.4	684				
615	-7.2	-13.1	-13.9	-9.7	685				
616	-1.3	-3.6	-3.8	-4.6	686	-0.6	-0.2	-0.2	-1.2
617	-3.8	-11.2	-12.2	-8.4	687	-0.6	+1.9	+1.8	-0.8
618	-2.5	-6.9	-8.5	-6.2	688	-5.1	-5.7	-7.4	-5.8
619	-5.2	-9.5	-10.0	-6.6	689	-3.5	-4.8	-5.0	-7.1
620	-0.4	-3.4	-5.0	-5.2	690	-3.5	-4.1	-5.1	-6.1
621	-0.1	-0.9	-1.9	-4.4	691	-3.7	-5.3	-6.3	-4.5
622	+0.4	+0.2	-0.5	-3.7	692	-6.4	-10.7	-11.4	-8.3
623	-1.9	-5.4	-3.9	-4.5	693	-5.5	-7.1	-7.8	-7.4
624	-6.8	-11.8	-9.7	-7.2	694	-6.5	-8.7	-10.1	-6.8
625	-1.2	-3.6	-3.1	-4.8	695	-2.1	-1.9	-3.4	-5.8
626	+0.8	+0.5	+0.7	-2.5	696	-4.9	-5.4	-5.2	-4.8
627	-0.6	-1.1	-3.1	-1.9	697	-2.4	-2.5	-4.2	-4.2
628	-2.2	-4.0	-4.3	-3.2	698	-2.2	-2.3	-2.7	-5.1
629	0.0	-1.8	-2.5	-2.0	699	-0.4	+0.2	+0.3	-2.2
630	-1.3	-2.1	-2.2	-2.2	701	+0.9	+1.1	-1.1	-1.1
631	-3.6	-4.5	-4.0	-4.0	702	+3.6	+6.2	+3.0	+1.5
632	-1.5	-8.5	-10.6	-4.0	703	+2.2	+3.4	+1.6	-1.4
633	-3.9	-5.3	-6.5	-2.4	704	+2.2	+4.9	+4.4	+2.5
634	-5.5	-11.4	-12.5	-5.3	705	+1.0	+3.2	+1.5	+1.2
635	-0.1	-0.3	-1.0	-1.7	706	+0.3	+2.0	+0.1	-1.2
636	-2.0	-3.0	-5.1	-2.0	707	+3.0	+4.7	+3.9	+2.1
637	-0.6	-1.1	-1.1	-1.0	708	+3.0	+4.1	+2.0	+0.5
638	-1.8	-3.3	-2.6	-1.8	709		+7.7	+1.6	-1.0
639	-4.0	-4.2	-5.2	-3.4	710	+4.3	+5.7	+3.1	+1.8
640	-1.8	-4.2	-4.9	-3.4	711	+1.4	+3.2	+1.2	+0.4
641	-2.8	-4.9	-6.2	-3.8	712	+2.9	+6.7	+6.0	+0.7
642	-2.7	-4.0	-5.5	-1.7	713	+3.4	+7.0	+7.1	+1.6
643	-3.0	-9.3	-11.4	-4.0	714	+6.3	+10.3	+9.9	+3.9
644	-1.8	-2.1	-3.3	-3.5	715	+0.2	+4.5	+1.2	-0.5
645	-3.9	-10.5	-10.4	-4.6	716	+3.8	+2.5	+4.5	-1.4
646	-3.2	-6.3	-7.8	-4.9	717	+1.5	+3.5	+5.3	+0.4
647	-4.1	-8.9	-9.9	-4.5	718				
648	-2.5	-4.1	-6.0	-3.0	719	+5.1	+9.1	+8.6	+3.6
649	+0.4	+0.1	-0.5	-0.1	720	+4.0	+7.6	+6.9	+1.1

TABLE 4. CONTD.

Gage Line	135# on 4 panels	270# on 4 panels	270# on 2 panels	Load Removed	Gage Line	135# on 4 panels	270# on 4 panels	270# on 2 panels	Load Removed
721	+5.3	+9.3	+10.0	+1.9	764	+0.6	+0.7	+7.7	-1.0
722	+1.0	+5.0	+2.8	+0.5	765	+0.9	+0.8	+0.2	-4.5
723	+1.1	+3.4	+2.3	+1.2	766	+0.6	+1.7	-0.8	-3.1
724	+0.8	+1.5	-0.1	-1.5	767	0.0	+2.8	+0.5	-0.1
725	+0.7	+1.3	+1.0	-1.0	768	+0.4	+3.7	+0.9	+0.4
726					769	+2.0	+4.6	+4.5	+0.9
727	+1.8	+1.1	+0.4	+0.3	770	+5.6	+12.6	+12.4	+4.8
728	-0.3	+0.7	+1.3	-0.7	771	+2.9	+6.4	+6.0	+2.5
729	+3.2	+5.2		+5.1	772				
730	+0.7	+4.1	+3.3	+1.7	773	+0.7	+1.7	+0.6	-1.5
731	+1.8	+3.9	+2.1	-0.8	774	+1.8	+3.3	+1.3	-2.2
732	+1.4	+2.6	+2.9	-0.4	775	+2.2	+2.6	+1.2	+0.3
733	+4.6	+10.8	+11.0	+4.2	776	+1.7	+0.5	+2.7	-1.3
734	+5.2	+10.9	+11.3	+3.6	777	+1.0	+7.2	+3.8	+1.7
735	+5.1	+8.9	+9.0	+4.7	778	+6.9	+12.9	+7.9	+4.8
736	+2.0	+6.3	+6.0	-1.6	779	+2.0	+5.3	+4.0	+2.6
737	-0.1	+2.8	+2.7	-1.8	780	+3.0	+5.3	+3.3	+3.5
738	-0.7	+2.1	+2.5	-3.4	781	+1.6	+4.2	+2.2	+0.1
739	+3.1	+7.9	+8.3	-1.0	782	-1.6	-2.9	-2.2	-3.1
740	+3.1	+6.4	+7.7	+1.7	783	-3.0	-5.0	-3.5	-4.4
741	+5.0	+9.0	+9.4	+2.6	784	+2.9	+4.3	+1.9	+1.1
742	+3.9	+8.4	+8.3	+1.8	785	-3.6	-3.6	-3.6	-3.1
743	+5.6	+7.6	+7.6	+4.8	786	-4.5	-6.9	-4.3	-4.8
744	+3.4	+5.4	+8.4	+2.9	787	-0.5	+0.9	0.0	-1.3
745	-1.4	+1.8	-1.2	-1.4	788	+0.4	+3.0	+1.3	-0.5
746					789	+2.0	+2.1	+1.5	+1.3
747	-0.2	+6.1	+5.6	+4.9	790	+1.1	+1.7	+1.0	-1.0
748	-0.1	+1.8	+0.9	-2.1	791	+1.4	+4.1	+2.5	+0.7
749	+0.1	+1.6	+0.1	-2.1	792	+1.9	+3.9	+1.8	-0.5
750	-1.0	-1.4	-1.4	-2.6	793	+0.5	+3.8	+1.4	-1.0
751	+0.5	+0.9	+1.7	-0.8	794	+2.7	+4.9	+2.5	+1.3
752	-2.0	-2.0	-1.8	-2.9	795	-0.4	+3.0	+0.5	-2.9
753	+0.2	+5.0	+5.9	+0.3	796	0.0	+2.5	+1.3	-2.1
754	+2.7	+7.0	+8.2	+2.6	797	+2.4	+2.9	+1.7	-0.7
755	+2.2	+3.3	+4.9	+0.5	798	+0.2	+0.9	-0.8	-2.5
756	-0.1	-0.2	-0.7	-3.1	799	+0.7	+3.8	+1.4	-0.8
757	+1.3	+3.4	+4.0	+0.8	800	-4.3	-6.5	-9.0	-6.1
758	-0.5	+1.6	+1.3	-1.6	801	-3.5	-6.4	-6.9	-7.2
759	+0.8	-0.2	-0.7	-3.7	802	+0.3	-0.7	-1.7	+0.2
760	+0.7	-1.1	-0.9	-1.8	803	-1.9	-5.7	-7.6	-4.4
761					804	-2.6	-8.2	-13.2	-8.5
762	0.0	-0.7	+0.3	-1.0	805	-1.1	-2.0	-2.1	-1.8
763	0.0	+1.3	+0.2	-1.5	806	+6.0	+15.0	+11.0	+5.3

+ = TENSION — = COMPRESSION

Note—Deformation readings are multiplied 5000 times, also, the deformations are for a distance of 8 inches, so for actual unit deformations figures given should be multiplied by 4000.

which gives Ms = WL/88 computed from stress in steel

$$\text{also} \quad \frac{111{,}000 \times 21\tfrac{1}{4} \times 12}{x'} = 1346 \times 319$$

whence x′ = 66,

which gives Ms = WL/66 computed from stress in concrete, or an average of Ms = WL/77 for strip B at the centre line of columns.

Strip A at Centre

As there is no reading on the concrete for strip A at the centre we cannot find the moment of inertia of this section.

By reference to Table 3 it will be noted that for the points of negative bending moment in strips A and B there is a fairly good agreement between the results obtained by test and those computed by the bending moments specified in the various codes, making allowance for tension in the concrete.

There is not a good agreement between the results obtained at the one point of positive bending moment for which readings were given so that I could be found.

This may possibly be partly due to the fact that the adjacent panels were not loaded which would have the effect of increasing the positive moments in the loaded panels.

Moments which correspond to results found by test:—

Mr = — WL/29

Mb = Could not be determined.

Mc = WL/44 A large variation partly due no doubt to adjoining panels not being loaded.

Ms = WL/77.

By-Products Coke Oven Plant at Sydney, N.S.

Large Installation Required Extensive Contractors' Plant—Difficulties in Obtaining Labor and Materials

THE Dominion Iron & Steel Company have a contract with H. Koppers Company, Pittsburgh, Pa., for the construction of a by-product coke plant. This new plant is to consist of 120 Koppers patented gross regenerative coke ovens in two batteries which contain 60 ovens each. The plant will have a capacity of 2200 tons of coal per day and will produce metallurgical coke for blast furnace use and will recover gas for heating purposes, and tar and ammonia.

The construction work on this plant is being done by the By-Products Coke Company of Canada, Ltd. This company has assembled all the necessary heavy construction equipment, such as locomotives, locomotive cranes, electrically-driven concrete mixers, concrete towers, electrical hoists, etc. This equipment was for the most part brought from the United States, as no heavy construction equipment of this kind was available in the Maritime Provinces. While the assembling of this equipment was expensive and caused some little delay in the start, the saving in time over the use of small equipment and of hand labor is sufficient to justify the initial expense incurred.

The labor market in Cape Breton for skilled and unskilled workmen has been very restricted since the beginning of the war. A great many men enlisted at the first call and others have left for points where higher wages are being paid in munition plants. More recently, the number of laborers has been reduced by the military service draft. On account of this labor shortage, it was necessary to import a great many men from distant points in order not to disturb labor conditions in an already overtaxed community. Some difficulty was had at first in securing men from distant points on account of a general impression that weather conditions in Cape Breton were unusually severe and that construction work during the winter months imposes a great hardship on the laborers. With some of the skilled labor, it was necessary to guarantee a minimum number of working days per month before they would consent to come. In most cases a bonus is paid on a sliding scale basis, which increases every three months. In addition, the men are given free railroad fare if they remain on the work for six months and return railroad fare if they remain until the work is completed.

Construction Camps

It was practically impossible to find suitable living quarters in the town of Sydney and it became necessary to build construction camps for all the skilled and semi-skilled labor, together with the necessary commissary for feeding the men. The bunk houses are built in small units, each house accommodating 36 men. The commissary is built in a "T" shape with three dining halls, one for unskilled labor, one for skilled labor and one smaller hall for foremen and sub-foremen. While practically the same food is served in each dining hall, it has been found that it works to better advantage to keep the men separated according to the character of their work. It also reduced the distance that the waiters have to travel from kitchen to the table, which is quite an item where 300 to 400 men are fed in the space of one-half hour.

Most of the common labor employed on this work are English speaking, and come from Newfoundland, Prince Edward Island, Nova Scotia and Eastern New Brunswick. They are well above the average of common labor in most districts. Most of them have small farms, and it is practically impossible to keep this labor during the planting and harvesting seasons, and also during the coldest months. They are accustomed to "work out" during their dull seasons, and on this account it has required a great deal of attention to keep a full complement of men on the work.

Hard to Get Sand and Gravel

One of the very grave difficulties encountered at Sydney was to secure sand and gravel for concreting purposes in sufficient quantities to complete the foundation work in time. On investigation it was found that there were no concerns equipped to supply the quantities needed, in fact there is not a screening plant in operation this side of Halifax, and for that reason it was necessary to recover and screen the material direct. So few of the good beaches are accessible by railroad that it was very hard to find a suitable beach where anywhere near the desired quantity could be secured. A gravel beach was finally discovered at Mira Bay, a distance of 22 miles by railroad from Sydney, on the Sydney & Louisburg Railway, where, by installing a spur track and screening plant, the necessary quantity could be secured. While the beach was convenient to the railroad, there was absolutely no labor in this territory or sufficient teams for scooping the gravel to the screening plant. It was necessary to erect a construction camp at the beach for housing and feeding the labor, horses, etc. While the gravel recovered was very good, the screenings contained a combination of silt, sand and loam, which was not suited for concreting purposes, and which had to be wasted. This made it necessary to look elsewhere for

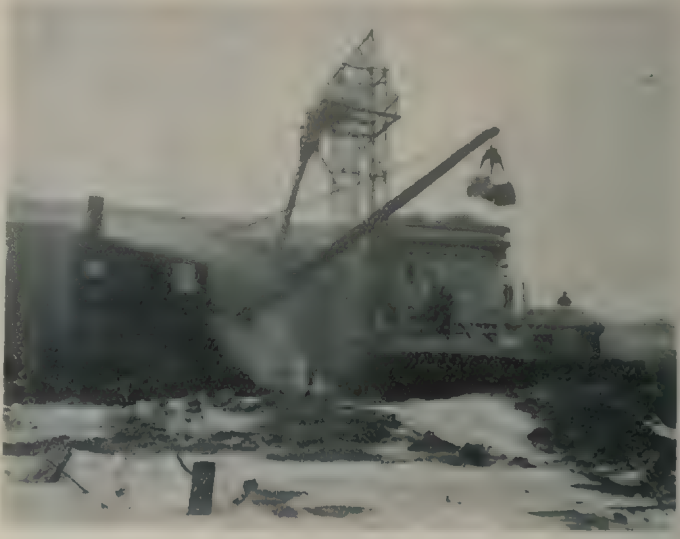


Fig. 1—Portable concrete mixer and tower car.

sand, which was finally found on a beach at Christmas Island, a distance of 50 miles from Sydney, on the Canadian Government Railway. It was possible only to secure sand in limited quantities owing to the isolated community and shortage of cars. While this sand was very sharp and excellent for concreting, it was too coarse for building for red brick work. The building sand was recovered from Sydney Mines, about 12 miles from Sydney.

Portable Mixing Plant

All the concrete was mixed and placed with a portable mixing plant, which consisted of an overhead storage hopper for sand and gravel with cement platform at top of batch hoppers, which in turn discharged into a three-quarter yard electric-driven rotary mixer and from the mixer into a hoist bucket at the bottom of a 35-foot tower. All of the equipment was mounted on a flat car and could be moved around the yard to any point (see Figure 1). As ample trackage was provided, the tower was of sufficient height to permit an easy flow through the spouts to the work without unnecessary hand mucking.

The material encountered in excavating for the various foundations was a combination of shale and hardpan with an underlying strata of rock, and in a great many places large springs were encountered which necessitated continuous pumping of all excavations to keep them sufficiently dry for form work and concreting purpoes.

The ovens proper were built under temporary sheds to protect the silica brick work from exposure to wet and cold weather. As the laws of Nova Scotia forbid the use of salamanders or open fires of any kind, it was necessary to install a hot air heating system. This was accomplished by using a sawdust suction plant which was secured from a dismantled car plant, and by reversing the operation it was made to blow over steam coils and piped to the oven sheds.

Necessarily, a large part of the material required for this plant must come from the United States. Under the present congested railroad conditions, there as well as here in Canada, and on account of the heavy snow storms encountered in Northern New Brunswick, freight movements have been very unsatisfactory. However, conditions are gradually becoming better and it is expected that freight will be moving at normal speed very soon.

City of Edmonton Waterworks Department Shows a Large Surplus for 1917

CITY COMMISSIONER A. G. HARRISON, of the city of Edmonton, advises that the waterworks department of that city shows a large surplus for 1917. The financial statement and balance sheet and the net result of the year's operation and management for the waterworks department for the year ending December 31, 1917, show that, after all expenditures have been met, including debenture interest, sinking fund, depreciation, and bank interest, as well as maintenance and operation charges, there is a surplus of $38,189.75. This is the best showing this department has made in the history of the city. For the year 1916 the surplus was $24,410.04.

The total revenue of the department for the twelve months ending December 31, 1917, was $368,868.15. The total expenditure was $330,678.40. The operation charges amounted to $160,920.72. The maintenance charges amounted to $22,986.42. The capital charges, including depreciation, were $146,771.26. Total mileage of mains under pressure in the system, 164.8 miles. Total cost of water-main maintenance for the year, $6,346.95, making the average cost of maintenance per mile $38.70.

During the year 168 new water services were installed and 132 house sewer services; total number of house sewer services to date, 9,602; total number of water services, 10,829; average cost of maintenance per water service, 73c. During the year a normal domestic pressure averaging 50 pounds per square inch has been maintained throughout the system on both sides of the river above the hill, while the pressure on the flats has averaged 110 pounds per square inch.

The fire department has been enabled by means of its own equipment to boost the water pressure for fire-fighting when and where necessary during the past year. This eliminates the necessity of boosting the pressure over the entire system of 164 miles of mains, and protects the entire system as well as the high-duty pumps at the pumping station against unnecessary strain.

The growth of the system has been remarkable during the last ten years. In 1908 the city had installed 2,520 water services, 200 hydrants, and 48.8 miles of water-mains. The revenue that year was $49,633.67. In 1917 the number of water services was 10,829; fire hydrants, 797; miles of water-mains, 164.8. The revenue was $368,868.15. The number of water meters in use in the city is 7,700. Average cost of maintenance per meter is 96½c. Since the installation of meters a great saving has been effected in the amount of water pumped.

Superintendent J. W. Turner and his staff are to be congratulated on the showing made, which is more remarkable owing to the world-wide adverse conditions as regards cost of labor and material. The service given has been constant throughout the whole period, and by regular daily tests the water supply is shown to be free from all contamination. One pound of liquid chlorine per million gallons was used to sterilize the water, and that was all that was found necessary, and proved to be far more economical than the old hypochloride of lime system.

Winnipeg Aqueduct Expenditures

The financial statement for the year ending December 31, 1917, issued by the Greater Winnipeg Water District commissioners, shows total liabilities of $11,275,587.96. On the aqueduct itself, according to the condensed statement of capital expenditure, a sum of $6,769,337.53 has so far been expended. Railway construction has cost $1,418,277.13, with $187,539.36 for equipment. The next highest item is the construction of the reinforced concrete pressure pipe line, which figures in the statement for $625,928.81. Financial charges appear for $551,439.93, material supplies and equipment are entered as $284,131.42, and railway operation at $267,326.49. Interest paid and accrued is shown to total $315,746.22. Among the liabilities appear $1,283,121.83 of 4½ inscribed stocks, and $7,500,000 5 per cent. five-year debentures, or a total of $8,783,112.83. The overdraft at the bank on December 31, 1917, was $1,042,995.41.

The Ottawa branch of the Canadian Society of Civil Engineers held their third meeting of the year on Thursday, March 21, when Col. R. W. Leonard, M. Can. Soc. C. E., delivered an address on "The Manufacture of Nicu Steel."

Interesting Law Case—City vs. Contractors

Digressions from Specifications Increase Costs—City Council Tries to Evade Consequences

A CASE which may be of interest to contractors and engineers generally in charge of construction works has recently been concluded where action was brought against the city of Hamilton by Brennan & Hollingsworth, contractors, in connection with extras entailed in the construction of sewers for the Kenilworth Avenue subway drainage, in the city of Hamilton. These sewers were, in the most part, laid in a shale rock excavation, and the decisions, which are enumerated hereafter, given by the trial judge as to common and reasonable practice in this class of excavation, are very important.

The considerations on which the contractors claimed extra compensation were enumerated by them, in effect, as follows:

1. The contract drawings exhibited at the time tenders were called did not show a plot of borings, but the contractors were given information in the city's engineering department that the rock would be encountered at specified depths at the outfall end and summit of the sewers, and that the rock would be fairly represented as being more or less on a sloping plane between these two elevations. As a matter of fact, the rock actually encountered exceeded the amount estimated on the above basis by some 600 cubic yards.

2. The plans showed the sewers to be constructed in the centre of the streets on which they were to be laid; they were laid out by the engineering department and caused to be constructed on a large percentage of the work on an offset line 10 feet from where they were shown to be on the contract drawings. This was claimed to entail greater depths of excavation and rock work; also pumping due to water encountered in the new excavation.

3. The profiles gave the figured depths from the ground level to the bottom of the excavation every 100 feet that the sewers were to be laid, the specifications stating "the trench for the sewer to be excavated to the depths and grades shown on the profile by a heavy black line," the black line indicating clearly the extreme depth of cut. There was approximately 700 feet of 24-inch sewer included in the deepest part of the contract, ranging from 13 to 19 feet deep, which had a concrete envelope around same 6 inches thick at the sides of the pipe and 4 inches underneath. The city interpreted their plans as showing the figured dimensions to the invert only, which naturally put the sewer down six inches deeper than shown by the drawings, in addition to a further depth of five inches due to the change in location.

4. On the line as re-located a heavy spring of water was encountered, originating in the centre of the new trench; the increased cost of pumping and incidental extra cost of excavation due to same was claimed.

5. On account of the greater amount of rock to remove there was necessarily a greater amount of surplus excavation to haul away, the voids in the rock when replaced being in excess of those of ordinary earth.

6. On account of the change in line of sewer no outlet for construction water at the commencement of the works was available or permitted by the department for drainage purposes, as was shown on the drawings to exist.

7. The city had undertaken with the Grand Trunk Railway Company to keep the subway pumped dry, pending the construction of the sewers. The city discharged their water in such a manner that considerable soakage took place from this source into the sewer excavations, which had to be removed in addition to the ordinary construction water.

8. The city had previously excavated for the subway, and in doing so sunk drill holes and blasted below subgrade; in constructing the sewers through this portion of the work an overbreak in the rock excavation at time aggregated 200 per cent.

9. In constructing the sewers, as previously stated, an envelope of concrete was shown by detail on the contract drawings to be required 6 inches thick at the sides of the pipes and 4 inches underneath. The wording of the specifications being "the width of the cut at bottom to be at least 8 inches wider than the diameter of pipe to admit of proper packing up to and along the sides." Taking the 24-inch pipe into consideration, this would mean, according to the detail, a width of 40 inches, there being 24 inches of pipe, two 2-inch walls, and two walls of concrete 6 inches thick. According to the specifications, however, a cut of 32 inches only would be required. This point was interpreted by the city engineer at the time of construction as meaning a cut wide enough to admit an average thickness of concrete of 6 inches, as the concrete was simply a filler between the pipe and rock side of the trench to prevent crushing of vitrified pipe, the rock being, in his opinion, as strong as the concrete. Later, however, the contractor was instructed to use a wooden template having a width slightly over 40 inches, to be run along the trench at all times ahead of the pipe, and that the trench should be at all times wide enough to permit of the template being placed over the top of the pipes when same were laid and before the concrete envelope was placed. Its use entailed an excessive overbreak in the rock, which gave the city an envelope average 10 inches in thickness. The additional rock excavation and necessary concrete to replace same was also claimed, as well as overbreak of rock to top of the trench.

There were several other smaller claims for extras, such as relocation of small drains and additional depths, jointing tile pipe from the inside as well as on the outside, leaky water-mains, non-delivery of pipe by the city, the contractors not being permitted to lay pipes and construct concrete appurtenances at the same time, owing to the fact that there was only one inspector on the works, all of which brought the amount claimed up to approximately $5,000.

Considerable correspondence took place as the work progressed, in which the contractors strenuously protested against the interpretation which was being put upon the specifications by the engineer, and the city were notified that payment would be expected for specified extras, the city engineer replying that payment would be made of what was right and fair at the completion of the work, and notifying the contractors to proceed with the work; also promising verbally on several occasions that they would be paid for extras as claimed.

During progress of the work the city were advised as to the cost, and on completion the amount spent was submitted to them in detail on request of the city engineer. The city engineer was prepared to pay an amount which would have been acceptable to himself and the contractors, and so recommended to the controllers. He found, however, that he could not get payment approved by the board of control, through whose hands the account had to pass, and finally stated that, under instructions of a sub-committee of the board, some $350 was all he could allow, and that any further amount the contractors felt was due them could be sued for.

Suit was entered, after considerable effort to effect a satisfactory settlement for the many changes which had been effected in the work, the relocation of the major portion of the sewers, and the claim that the original contract did not apply, as it could not be recognized in the work as actually carried out. On a writ being issued by the contractors, a cheque for approximately $500 was issued by the city to them to cover extras; this was accepted by the contractors in part payment only of their claim.

Upon hearing this action, after considerable evidence had been taken and experts examined, the trial judge, Mr. Justice Clute, at the close of the argument made the following remarks:

"Permit me to make one remark.; perhaps it will not be of the slightest use; it will not delay me in my judgment, but it seems to me that this case is one where, I do not say in legal justice, but as between man and man, the parties might yet very well come to an arrangement. There is no doubt this drain cost more than the estimates of the city, very considerably more, and, as it turned out, both the city and the contractors mistook the quantity of rock to be taken out, and the money of the plaintiffs, under peculiar circumstances, has gone into that. It comes very close, in my opinion, to a moral duty to consider that question now. I do not think it does a city any more harm than an individual to do what is right."

The following is a memorandum from reasons of judgment of Mr. Justice Clute:

"The plaintiffs are not entitled to rely on Taylor's representations. There were plans and specifications. The plaintiffs were bound to satisfy themselves by digging pits, etc.

"The contract was not changed. The engineer, under the contract, could change the line.

"I find that the plaintiffs were requested by the engineer to go on with the work, and they would be paid what was fair and right under the contract.

"The engineer was not an indifferent and impartial arbitrator as between the parties, nor was he free from continual pressure brought to bear up him by the board of control.

"The plaintiffs were not bound by the action of the engineer in respect of any dispute arising under the contract between the parties.

"The plaintiffs are entitled to extra costs in respect of the following items:

"1. Extra depth at which the sewer was placed. Dispute arose under the construction of the plan as to whether the depth should be measured to what is called the 'invert'—that is, the inside of the pipe—or the actual depth of the sewer. I find in construing the meaning of the contract and plan itself, and upon evidence, that what is called the 'black line' shown on plan exhibit 7, indicates the bottom of the sewer, and that, under the instructions of the engineer in charge, the depth was increased, and to the expense of this extra depth the plaintiffs are entitled to be allowed.

"2. The plaintiffs are entitled to the increased cost caused by the plaintiffs being compelled to use a templet in the construction of the sewer, both in respect of the width and of the extra overbreak.

"3. They are entitled, also, to the cost of cementing the pipes on the inside, the cost of removing the water and otherwise caused by the spring struck on the changed line, and in extra gully drain pipe and construction cost due to the change in the width of roadway and to relocation of gully drain; extra pumping not provided for in specifications; extra expense of leak of water in the water-main.

"Various items of expense in constructing the sewer were recommended by the engineer, and were not, as I gathered from his evidence, disputed.

"No doubt there may be further evidence offered on both sides in case of a reference, but from the evidence already in I am able to form a fair idea of what would be a reasonable allowance for extras on the contract, and if counsel desire, in order to save the expense of a reference, that I should give expression of my views, I will do so if such request is made within a week."

Immediately this judgment was made in favor of the contractors the city took steps to appeal from the decision of the trial judge. This appeal, however, was not taken by the city, as settlement was made in the matter, the city agreeing to pay $2,500.

Preliminary Figures on Canada's Mineral Production in 1917

The preliminary report on the mineral production of Canada during the year 1917 has just been issued by the Mines Branch of the Department of Mines. This report, which was prepared by John McLeish, B.A., chief of the Division of Mineral Resources and Statistics, contains a quantity of valuable data, and we are printing below some figures taken from it which may be of interest to our readers.

The total value of the mineral production in the Dominion for 1917 was $192,982,837, as compared with $177,201,534 in 1916, all the principal products, with the exception of copper, gold, pig iron, and stone showing an increase in value. In the quantities produced, however, copper, gold, pig iron, lead, silver, asbestos and asbestic, coal, graphite, gypsum and cement register decreases.

Copper

The production of copper in 1917 amounted to 108,860,358 pounds, valued at $29,588,254, as against 117,150,028 pounds, valued at $31,867,150, in 1916, a decrease of 7.08 per cent. in quantity and 7.15 per cent. in value. Though less than the previous year, the production was greater than any other previous record. In 1916 the increase over the production of 1915 had been 16.2 per cent. in quantity and 83 per cent. in value.

Gold

The total production of gold in placer and mill bullion and in smelter production in 1917 is estimated at 747,366 fine ounces, valued at $15,449,426, as compared with 930,492 fine ounces, valued at $19,234,976, in 1916, a decrease of $3,785,550, or 19.68 per cent. This has been the lowest since 1912, when the new Porcupine field caused a considerable increase in Canada's production of gold.

Lead

The earlier estimates of the production of lead in 1917 included the recoveries of considerable quantities of lead from imported ores. The total production in 1917 of lead in bullion credited to Canadian mines, together with the lead estimated as recoverable from ores exported, was 32,072,269 pounds, which at the average price of lead in Montreal, 11.137 cents per pound, would be worth $3,571,889. The corresponding production in 1916 was 41,497,715 pounds, valued at $3,532,692, an average price of 8.513 cents. The decrease in quantity was 9,425,346 pounds, or 22.7 per cent., but on account of the higher price there was a slight increase in total value.

Nickel

The production of nickel in 1917 has, as usual, been derived from the ores of the Sudbury district, supplemented by the recovery of a small quantity of metallic nickel, nickel oxide, and other nickel salts as by-products in the treatment of ores from the silver-cobalt-nickel ores of the Cobalt district.

The total production was 84,470,970 pounds, worth, at 40 cents per pound, $33,778,388, compared with 82,958,564 pounds, valued at $29,035,497, or 35 cents per pound, in 1916.

Silver

The production in silver of 1917 was 22,150,680 ounces, valued at $18,034,419, as against 25,459,741 ounces, valued at $16,717,121, in 1916, a decrease of 13.0 per cent. in quantity, but an increase of 7.9 per cent. in value. The high value of the production in 1917 was exceeded only in 1912 and 1913, when the Cobalt camp was at the maximum of its output.

Iron Ore and Pig Iron

The total shipments of iron ores from Canadian mines during 1917 were 215,242 short tons, valued at $758,261, as compared with shipments of 275,176 tons, valued at $715,107, in 1916. The 1917 shipments included 198,092 tons from mines in Ontario and 17,150 tons from mines in Quebec, and of the latter amount a considerable tonnage was from old stock piles. The ores comprised 197,602 tons of hematite and roasted hematite and siderite, 12,664 tons of magnetite, and 4,978 tons of titaniferous ores.

The production of pig iron in blast furnaces during 1917 was supplemented by a small production of high-grade low phosphorus pig iron in electric furnaces made from shell turnings and other steel scrap. The total production from both sources (not including the output of spiegeleisen, or other ferro-alloys) was approximately 1,171,789 short tons (1,046,240 gross), final returns not yet having been received from all manufacturers of electric pig iron. Of the total, 1,156,789 tons were produced in blast furnaces and the balance in electric furnaces. In 1916 the production all made in blast furnaces was 1,169,257 short tons (1,043,979 long tons).

Steel Production

Final returns for all the operations in connection with the manufacture of steel had not been received when the report was prepared. The estimated production of steel ingots and direct steel castings, however, is shown as 1,736,514 short tons, of which 1,690,190 tons were ingots and 46,344 tons direct steel castings. The total production in 1916 was 1,428,249 tons, compared with which the 1917 production shows an increase of 308,265 tons, or 21.6 per cent. The total production of electric steel in 1917 was probably not less than 50,000 tons, as against 19,639 tons in 1916 and 5,625 tons in 1915.

Asbestos

The total output of asbestos in 1917 was 150,308 tons, and the sales were 144,185, valued at $7,215,389. In 1916 the figures were: Output, 118,247 tons; sales, 133,439 tons, amounting to $5,199,797. The exports in 1917 were 93,932 tons, at an average value of $52.20 per ton, against 96,775 tons in 1916, at a value of $40.01 per ton.

Coal

The production, imports, exports, and consumption of coal during 1916 and 1917 are shown in Table I.

Table I.

	1916.		1917.	
	Short tons.	Value.	Short tons.	Value.
Production	14,483.395	$38,817,481	14,015,588	$47,643,646
Exports	2,135,359	7,099,387	1,733,156	7,387,192
Imports	17,580,603	38,289.666	20,857,460	70,562,357
Consumption	29,928,139	....	33,139,892	....

Table II., below, shows the production of structural materials and clay products during 1917. The total value of the 1916 output was $17,467,186, so that the 1917 figures show an increase of $1,635,385, or 9.4 per cent. This is the first increase in production of this class of products that has been recorded since 1913, the total having been $17,467,186 in 1916, $17,920,759 in 1915, and $26,009,227 in 1914.

Table II.—Structural Materials and Clay Products ....

	Quantity.	Value.
Cement, portland, barrels	4.768,488	$7,699,521
Clay products: $4,603,755—		
Brick: Common	....	2,017,046
Brick: Pressed and paving	....	589,406
Kaolin, tons	533	9,594
Pottery	....	122,878
Refractories: Fireclay, firebrick, etc.	....	210,838
Sewer pipe	....	778,159
Tile	....	434,465
All other: Fireproofing, hollow blocks, etc.	....	441,369
Lime, bushels	6,338,212	1,517,918
Sand and gravel, tons	7,157,279	1,908,773
Sand-lime brick, number	12,432,990	143,393
Slate. sq.	1,422	7,789
Stone: $3,221,422—		
Granite	....	613,588
Limestone	....	2,291,692
Marble	....	55,820
Sandstone	....	260,322
Total structural materials and clay products	....	19,102,571

Cement

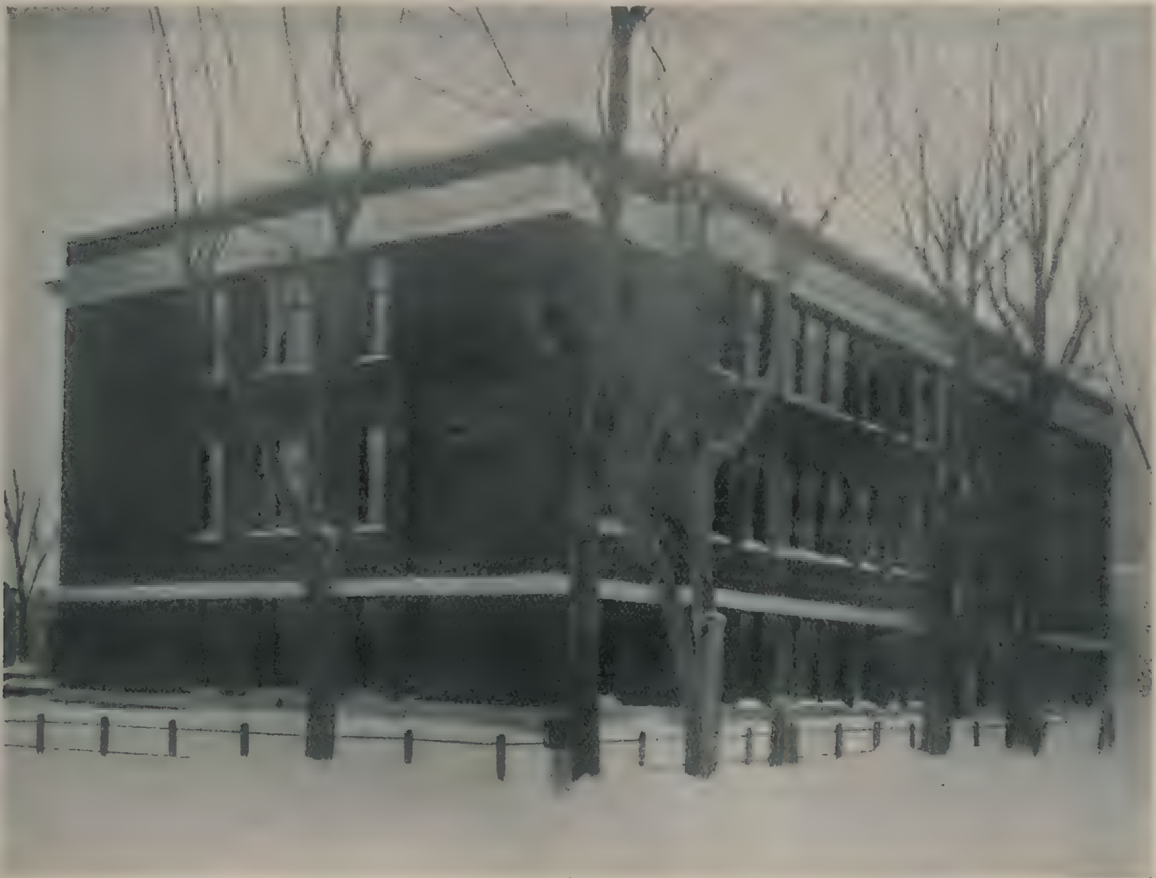
The total quantity of Portland cement sold or used in 1917 was 4,768,488 barrels of 350 pounds each, valued at $7,699,521, or an average of $1.61 per barrel, as compared with 5,369,560 barrels sold, or used in 1916, valued at $6,547,728, or an average of $1.22 per barrel, showing a decrease in quantity of 601,072 barrels, or 11.2 per cent., but an increase in total value of $1,151,793, or 17.6 per cent.

Clay Products

The value of clay products produced in 1917 was $482,950 greater than in 1916. Common brick showed an increase in value of $190,202; pressed and paving brick, an increase of $66,907; sewer pipe, an increase of $61,870; and tile, $85,078.

The St. Phillippe School, Three Rivers

THE School Commissioners of Three Rivers, P.Q., with a view to providing one of the best equipped boys' schools in the province, instructed Messrs. Asselin & Brousseau, architects, of Three Rivers and Montreal, to draw plans for a three-storey structure—the St. Phillipe School—containing fourteen class rooms. The general contract for the erection was awarded to Nobert-Dugre & Arsenault, Limited, engineers and contractors, Three Rivers. The school consists of three storeys and an extension of two storeys, covering an area of 143 x 115 feet. The foundations are of reinforced concrete with an exterior of rustic brick and trimmings of Deschambault stone. The exterior has some slight ornamentation of brick panels, the inscription, Ecole St. Phillipe, of stone, being placed in the centre of the building above the main entrance. The school has light on the four sides.



The chief entrance, on the ground floor, leads to a waiting room and offices on one side, and to a dining room for the Christian Brothers on the other. These rooms are flanked on each side by class rooms and toilets, the former having hardwood floors and the latter asphalt floors. Corridors divide the class rooms on this and the other floors. A large recreation room, with asphalt floor, is placed in the extension on the ground floor, together with accommodation for the heating, ventilation, and vacuum apparatus, the chimney being of brick and 55 feet high. The ventilating fans and vacuum cleaner are run by electricity. The boilers and other appliances are shut off from the recreation room by a 16 inch brick wall.

The second and third floors each contain five class rooms, with central corridors, and with the toilets at either end. Every class room has a cloak room. On the second floor, in the extension, there is a very large lecture hall, divided from the class rooms by a 16-inch brick wall. The corridors are of wood and glass, while the class rooms have partitions of wood and plaster. There are entrances at each end of the building, the walls of the stairways being of 16-inch brick, making them practically fireproof. Two further entrances at the rear of the building give access to the recreation room on the ground floor. Iron fire escapes are provided on each floor, and are situated at either side of the building. The walls of the toilets are of slate. The roof is of tar and gravel. Provision is made on the top storey for the pipes for ventilating purposes.

The entire school is laid out to give easy access for the scholars, practically all the floors being on the same plan.

The lumber was supplied by MacFarlane & Co., Ltd., Montreal; the stone by the Companie des Carriere, Deschambault; windows and doors, Pothier and Girardeau, Three Rivers; hardware, H. Nobert, Three Rivers; heating, plumbing and ventilation, and roofing, Hamelin & Son, Three Rivers; brick, National Brick Company of Laprairie, Montreal; fire escapes, Dominion Architectural Iron Works, Ltd., Montreal; electrical work and motors, North Shore Power Company; asphalt, Johns-Manville Co., Ltd., Montreal.

Organization of Iron and Steel Section of the C. M. I.

An iron and steel section of the Canadian Mining Institute is now being organized. The decision to form this section was come to at the annual meeting of the institute, held in Montreal. The question was discussed at great length, some length, some members favoring the organization of a Canadian iron and steel institute, with possible affiliation with the Mining Institute, while others desired the formation of a new society, "under the auspices of the Canadian Mining Institute, as an iron and steel section, and that provision be made for launching out as an independent organization if this should at any time be considered necessary." The president, Mr. A. A. Cole, favored a section united to the Mining Institute, and outlined a scheme whereby the latter, with its various sections, might work with the Canadian Society of Civil Engineers, possibly later on agreeing to all centralize in the same building, with the various branches working separately.

It was finally decided to form an iron and steel section of the Mining Institute, the following being appointed an organizing committee: Messrs. Robert Hobson, Hamilton; Col. Thomas Cantley, Mark Workman, W. C. Franz, Dr. Alfred Stansfield, W. J. Jansen, H. H. Jacquays, J. A. Irwin, C. F. Bristol, Esmond Peck, G. H. Duggan, and P. L. Miller, of Montreal; F. H. Macdougal, Sydney, N.S.; F. Crockard, New Glasgow, N.S.; J. J. Hartley, Kingston; George W. Watts and William Ingols, Toronto; J. G. Morrow, F. A. Sherman, and W. M. Curry, Hamilton; Col. David Carnegie, Ottawa; Capt. David Kyle, Sault Ste. Marie; M. Deakins, Winnipeg; Fleet Robertson, Vancouver; and George McKenzie.

Engineering in the Navy

Commander J. W. Skentelbery, R.N., Member of the British Institution of Naval Architects, and representative of the Royal Navy in Canada, spoke on "Engineering Activities in Connection with the Work of the Navy" at a meeting of the Canadian Society of Civil Engineers, Montreal, on March 14. The address largely related to the wonderful work being done in all parts of the world by the Navy, and from its nature cannot be published in detail. Commander Skentelbery related how Great Britain had taken measures to combat the submarine menace, how the shipbuilding program had been expended, and how the simple fishermen of Great Britain had risked their lives in doing magnificent work on the drifters and trawlers. With regard to the building of submarines the speaker outlined the organization by which engineering firms were given out various parts to make which were then assembled, with the result that the work was done with great rapidity and with great accuracy. The government had built a large number of new types of war vessels, including what were known as "Blister" ships; the "Flower" class, a cross between a torpedo boat destroyer and a high-class trawler, which had been of material assistance in convoying vessels; and many monitors, the latter being turned out in record time. In the opinion of Commander Skentelbery the standardization of ships could never be a success, but he insisted that it was of the most vital importance that the quality of the machinery should be of the highest, as a breakdown at sea might mean the loss of the vessel.

The speaker then briefly described the nets used by the trawlers to catch submarines, together with the indicator buoys and the depth charges to destroy the submarines. He also gave particulars of the work of the Priority Board and the Dilution of Labor Department in England.

In speaking to them as engineers he desired to emphasize the point that "the war is not a fight for England; it is for yourselves. It is our duty as engineers to stick it out to a finish." He had no doubt as to the result, with the aid of the United States and the Dominions, in freeing the world from the curse of military autocracy.

Mr. J. L. Busfield also read a summary of a paper by Dr. W. Bell Dawson, M.C.S.C.E., F.R.S.C., on "Datum Planes Related to the Tide."

Repairing Disintegrated Concrete on Dam with Cement Gun

An interesting job of repairing disintegrated concrete on the face of a dam by means of the cement gun has been carried out recently for the Consolidation Coal Company, at Jenkins, Ky., and is described in Engineering and Contracting.

The dam, which was built in 1911, is about 40 ft. high and 200 ft. long, and forms a water supply for the power station furnishing electric current to the mines and other plants throughout Elkhorn Valley.

For the construction it was necessary to haul all cement and lumber over the mountains by team, the aggregate being supplied by crushing rock near the dam site. No sand being available, very fine crushed rock was used, and this stone dust has evidently caused an inferior concrete, which has readily been attacked by frost, as the face has eroded to as great a depth as 18 in. in numerous places. Very little disintegration has taken place on the upstream face or at the spillway end.

In making the repairs all loose concrete was removed from the entire down-stream face and top by means of pneumatic chisels. Holes were drilled about 30 in. on centre, into which ½ in. x 4 in. rail spikes were driven, leaving the head projecting about 1 in. No. 7-A American Steel and Wire triangular mesh was then fastened to the spikes by several strands of No. 14 wire at each spike.

The top and entire down-stream face was coated with 3 in. to 18 in. of Gunite, with the exception of a few large leaks in the dam at contraction cracks where no expansion joints had been provided in the dam when built. The mixture consisted of one part cement to three parts sand.

The work of coating began at the top, and when a leak was encountered the Gunite was applied up to each side of the leak, leaving a margin of several inches. After the entire down-stream face was covered in this manner the water was lowered about five feet, and work was begun on the up-stream face. Wherever a crack appeared on the up-stream face it was opened up with chisels to a depth of about 5 in. and 1 in. wide on the face. This crack was painted nearly full with hot asphalt and then three layers of heavy burlap were painted over the crack with heavy coats of asphalt so that they extended about 12 in. each side of the crack.

Wire mesh was then secured by means of spikes to the concrete, and the entire up-stream surface coated with Gunite to a thickness of about 3 in. The water was then lowered several feet and the process repeated until the water had been lowered about 20 ft. and the leaks on the down-stream face had ceased to flow. These leaks on the down-stream face were then sandblasted through the wire mesh, washed out, and filled up with Gunite.

It is anticipated that the Gunite may crack during cold weather in both the up-stream and down-stream faces along the lines of the old openings, but that the asphalt joint as constructed will prevent water from entering the concrete and causing further disintegration.

Mr. W. B. Champ Elected Managing Director Hamilton Bridge Co.

Mr. Walter Baker Champ, who has for many years been secretary-treasurer of the Hamilton Bridge Works Company, Limited, and who was last week elected managing director and secretary of the company, was born in Hamilton, March 23rd, 1874. His entire business career has been with the Hamilton Bridge Works Company, having joined that firm when he was only 17 years old. He was appointed treasurer of the company when only 24 years of age, and seven years later he was made secretary-treasurer. He has been a director of the company since 1910. Mr. Champ is a member of the Hamilton Board of Trade and was president of that organization for the year 1909. He is a member of the Canadian Manufacturers' Association and served on the executive council of that association from 1909 to 1912. As managing director of the Hamilton Bridge Works Company he succeeds the late R. Maitland Roy, Mem. Can. Soc. C. E. Mr. Champ has been acting manager of the company since Mr. Roy's death in July, 1916.

Mr. W. B. Champ.

New Members of C.S.C.E.

The following have been elected members, associate members, etc., of the Canadian Society of Civil Engineers:—

Associate members—Messrs. A. W. Gray, Major with the C. R. T. on bridge construction, France, and previously chief highway engineer for the Parks Branch, Department of the Interior; J. F. Greene, Winnipeg, construction engineer for the Carter-Halls-Aldinger Co., Winnipeg; N. Lowden, Victoria, B.C., Lieut. on gauge railway construction, France, previously assistant engineer, city engineer's office, Victoria; R. J. Swain, St. Boniface, Man., city electrician, city of St. Boniface.

Transferred from associate members to members—Messrs. M. B. Atkinson, Westmount, P.Q., assistant chief draughtsman, Board of Engineers, Quebec Bridge; W. P. Brereton, Winnipeg, city engineer, City of Winnipeg, in direct control of operation of all pumping plants, quarries, gravel pits, asphalt plant; A. E. Foreman, Public Works engineer, Provincial Government, Victoria, B.C.; L. M. Jones, city engineer, Port Arthur, Ont., in charge of design, construction, and maintenance of all municipal works and public utilities; A. J. Meyers, Montreal, chief draughtsman, Board of Engineers, Quebec Bridge.

Transferred from junior to associate member—Mr. J. P. Vaughan Cowley, Victoria, C.E.F., and previously in the engineer's department, City Hall, Victoria, B.C.

Transferred from student to junior—Messrs. L. I. Easton, Lieut. in 14th Field Company Engineers, and previously resident engineer, Hudson Bay Railway; D. DeC. Ross-Ross, assistant engineer of H.M.C.S. "Hochelaga," Halifax.

Engineering Society Elects Officers

The University of Toronto Engineering Society has elected its officers for 1918-19 as follows: President, D. K. E. Strathearn; vice-president, G. E. Bennett; treasurer, C. G. R. Armstrong; corresponding secretary, F. R. Macdonald; recording secretary, K. M. Beck; curator, G. Queen. Club presidents: Civil, E. C. Cowan; E. and M., T. W. Campbell; arch, W. A. Mollard; chem., A. R. Clarry; senior Varsity representative, A. Hambleton; junior Varsity representative, A. D. R. Faser. Year representatives: IV., J. E. Hess; III., R. D. Keenleyside; II., F. W. Dunton.

It is stated by La Nature that over nine million horse-power is obtainable from French rivers 180 days in the year. Corresponding figures for other European countries show that France is especially favored in this respect, her water-power resources being considerably larger than those of Norway, Sweden, or Italy, or, in fact, of any other country, except perhaps Russia, for which no statistics are given. It is also interesting to note that, although the German available water resources only amount to about one and one-half million horse-power per annum, she has utilized 31 per cent. of them, whereas only 10 per cent. of French water-power is yet developed.

The third one of a series of papers on "Good Roads" was read by Mr. H. R. Mackenzie, A.M. Can. Soc. C.E., before a meeting of the Saskatchewan branch of the Canadian Society of Civil Engineers on March 14, in connection with the monthly dinner at the Assiniboia Club. The energies of the branch are being devoted to the studies of the two questions, "Good Roads" and "Power" exclusively.

The Council of the Canadian Society of Civil Engineers has sanctioned the formation of branches at Halifax, N.S., and St. John, N.B.

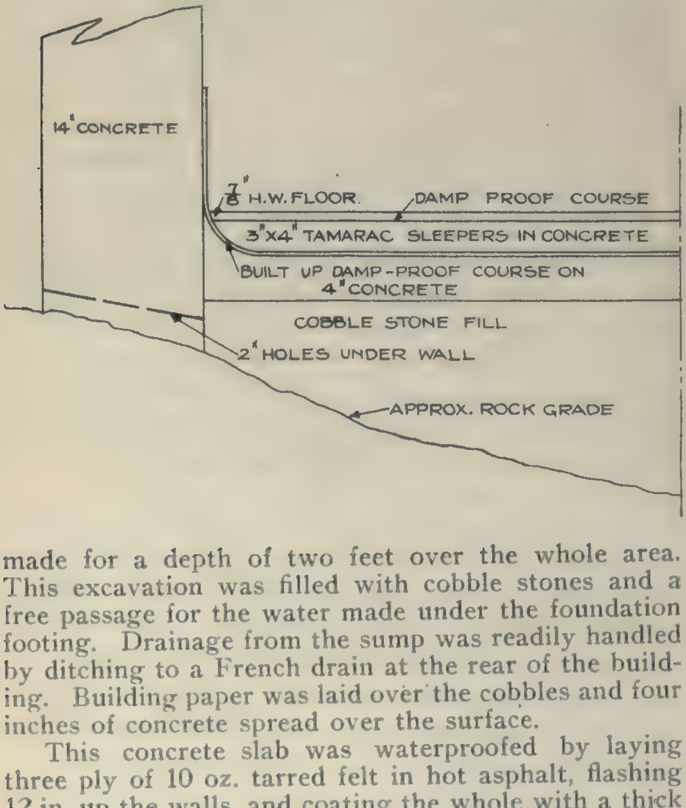
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Solution of Difficult Waterproofing Problem

IN a hospital recently erected in the Muskoka district an up-to-date X-ray plant was installed in the basement. The natural slope of the rock was such that the seepage from several acres of overlying soil would be obstructed by the foundation walls. No provision had been made for the drainage of this water, and consequently in the particular location of the X-ray installation considerable water accumulated. An attempt to waterproof the walls failed, and it was decided to let the water run to a sump hole.

The cement floor was removed and an excavation made for a depth of two feet over the whole area. This excavation was filled with cobble stones and a free passage for the water made under the foundation footing. Drainage from the sump was readily handled by ditching to a French drain at the rear of the building. Building paper was laid over the cobbles and four inches of concrete spread over the surface.



This concrete slab was waterproofed by laying three ply of 10 oz. tarred felt in hot asphalt, flashing 12 in. up the walls, and coating the whole with a thick coat of asphalt. Sleepers to receive the wood floor were then levelled and concrete poured flush with the tops of strips. After marking the location of the bedstrips a further coating of asphalt and felt paper was applied and the hardwood floor laid. This method of handling the water proved satisfactory.

Speedy and Efficient Methods in Reservoir Construction

By G. Graham Reid

A unique example of combining speed and economy occurred last fall in the construction of a 100,000 gallon reservoir of reinforced concrete for the town of Strathroy. The location selected as being most convenient for the reservoir was in marshy ground and underlaid by quicksand to a great depth. Care had, therefore, to be taken that no seams should weaken the structure, and it had to be heavily reinforced. It was decided on consideration of these conditions to pour the walls and roof continuously, necessitating a double shift. The work had been delayed to secure the approval of the Provincial Board of Health to the project, and it was late in the year when construction was finally decided upon and tenders called.

Showing arrangement of reinforcing and runways.

The work was begun in three shifts of eight hours, and when concrete was started a twelve-hour shift was employed to utilize the limited supply of labor. Towers and spouting were eliminated by raising the mixer, a half-yard machine of the batch type, to the elevation required to dump into carts operated on the roof falsework.

The reservoir was completed in two weeks, and the cost of placing the concrete proved less than ordinarily figured for this class of work when carried on in daytime only. The cost of placing the reinforcing ran slightly higher than it would had it been done altogether in the daytime, but, on the whole, a considerable saving was effected by suitably arranging the shifts, continuously operating the plant, and placing the mixer, and the work was completed well within the specified time, to the satisfaction of all concerned. The engineering work was carried out by Kerry & Chace, Ltd., Toronto, and the writer was the contractor.

A novel way of placing gravel in the ruts of a roadway was recently devised by a road engineer. In addition to the ordinary tail-board of the wagon or truck, two smaller openings were made. Instead of dumping the gravel or stone in a heap, two small streams were directed to the ruts by means of chutes. The tilt or elevation of the body and the size of the opening were regulated so as to give the required amount of gravel or stone to fill the rut.

Mainly Constructional

East and West—From Coast to Coast

A company has recently been formed for the purpose of building a cordage factory on the Pacific Coast. About $250,000 is to be spent on the plant and it will probably be located at Nelson.

The British-American Shipbuilding Company propose to establish a shipbuilding plant at Vancouver and have reached an agreement with the Harbor Board in regard to a site on the Kitsilano Indian Reserve.

Nearly all the municipalities on the line of the proposed Sherbrooke-Montreal highway have passed the necessary resolutions applying for grants under the Good Roads Act and it is probable that the establishment of the highway will soon be realized.

Legislation is being introduced in New Brunswick in connection with the compensation of workmen, under which an injured man will receive payment from a general fund assessed upon the employers according to the class of industry in which they may be engaged.

A new highway Act has been introduced in the New Brunswick Legislature, which provides for the division of the roads into two branches—trunk roads, which remain directly under the control of the government, and branch roads, which are given over to the control of the parishes.

The site of the old Martello Tower in Point Pleasant Park at Halifax has been recommended to the naval authorities as the most suitable for the Royal Canadian Naval College, which has been temporarily located at Kingston. Prior to the explosion the students were housed in premises at the dockyard, but these were considered too limited.

Arrangements have been completed by New York capitalists for the establishment of a steel plant in British Columbia. The lease has been signed in Ottawa for a tract of the Indian Reserve on the north arm of the Fraser River near New Westminster. Work on the plant is to start in sixty days and the company is to commence with fifty tons of steel a day, the output to be increased to one hundred. Steel billets, rods, plates, etc., will be rolled. The electrical process will be used in the manufacture.

Mr. A. D. Creer, engineer of the Vancouver and Districts Joint Sewerage Board, recommends that a permanent maintenance gang be employed on the system. He points out that the sewerage system constructed is worth over $2,000,000 and consists of over 20 miles of large trunk sewer. The cost of maintenance by such a gang would be about one-quarter of one per cent. The 1918 expense allotments have been brought down by the Board and comprise together some $115,236.93, Vancouver's share being $72,403.55.

A verdict of $208,000 was handed down recently by Justice Masten in the non-jury court in favor of the Canadian Stewart Company and against the I. A. Hodge Company, of Syracuse, N.Y. The latter firm was sub-contractor to the Canadian Stewart Co. on their contract in connection with the Toronto Harbor improvements. Its work consisted of pile-driving, which, it was claimed, was done improperly, and through the alleged negligence the Department of Public Works refused to pass the piling, which had to be done over again.

The steamship "Faith," which is said to be the largest concrete vessel yet constructed, was recently launched at a port on the Pacific Coast, showing up so satisfactorily that her builders announce that they will immediately commence work on 54 similar ships of larger size, all of which they expect will be completed within eighteen months. The launching was from an open field and the only plant was a couple of construction sheds and a spur track. The builders declare that this is all the preparation necessary and that material is always at hand or nearby, so that the necessity of costly shipyards and long hauls is thus eliminated.

The orders for railroad equipment recently placed by the Dominion Government total about $22,500,000, distributed as follows: Canadian Car and Foundry Co., Montreal, five thousand forty-ton steel frame box cars, 450 forty-ton wood ballast cars, 300 thirty-ton stock cars, worth in all about $16,000,000. Eastern Car Company, Trenton, N.S., seven hundred and fifty forty-ton steel frame flat cars, and 650 fifty-ton steel coal cars, worth in all about $3,750,000. National Steel Car Company, Hamilton, Ont., one thousand forty-ton steel frame box cars, worth in all about $2,750,000. The bulk of the equipment, especially box and ballast cars, will be for the Canadian Northern Railway.

The Appellate Division has dismissed the appeal of the Milton Pressed Brick Company from the decision of the local judge at Welland regarding their claim for a lien for the price of bricks sold to a contractor who has since failed, the bricks having been delivered in front of the building in question but never actually having reached the latter. "No case," said Mr. Justice Hodgins, "has yet decided that a lien under the Mechanics' Lien Act, either on the land or the material itself, exists by the mere appropriation of goods to a contract or on the delivery to the owner or contractor unless they are placed upon or reach the lands to be affected. Proximity to the land is not enough; it must be on it so that, either in fact or in contemplation of the law, the value of the land itself is enhanced by its presence."

Personals

Capt. E. R. Taylor, R.E., of Victoria, B.C., a 1914 graduate of McGill and formerly engaged by the government in civil engineering work, has received the Military Cross.

Mr. John Hole, Sr., who for the past two years has been assistant superintendent of construction for the Toronto Harbor Commission, is resigning that position to enter private practice as an engineer and contractor.

Mr. M. A. Black, C.E., a graduate of McGill University, has been appointed manager of the new concrete manufactures plant of J. J. McCaffrey, at South Devon, N.B. Mr. Black has recently been with the Grand Trunk Railway at Windsor, Ont.

Mr. Howard Taylor, who for some years has been chief electrical and mechanical engineer of the Spanish River Pulp and Paper Company, has resigned to become consulting engineer with the Dayton-Wright Aeroplane Company, at Dayton, Ohio.

Gavin N. Houston, M. Can. Soc. C. E., formerly with the irrigation office, Department of Interior, at Calgary, has been appointed supervising engineer on the construction of the fifty-million-dollar explosives plant which the United States Government is building at Charleston, West Virginia.

Lieut.-Col. W. G. MacKendrick, D.S.O., has returned to his home in Toronto on furlough after twenty-eight months' service overseas. Col. MacKendrick, who in civilian life was president of the Warren Bituminous Paving Company, went overseas at his own expense after the outbreak of war and offered his services to the British War Office, which granted him a captaincy in the Royal Engineers. Before long his ability as a road builder drew the attention of the authorities and he was promoted to rank of Lieutenant-Colonel and appointed Director of Roads with the Fifth British Army.

Tenders and For Sale Department

Tenders Wanted

On a structural steel intercommunicating bridge, 50 ft. span and a structural steel cupola 15 ft. x 20 ft. x 55 ft. high. Plans and specifications and all particulars may be obtained at the office of McFarlane-Pratt-Hanley, Limited, Midland, Ont.
13 14

Tenders Wanted

For four Automatic Fireproof Doors on belt tunnels between two Grain Elevators. Particulars given at the office of McFarlane-Pratt-Hanley, Limited, Midland, Ont. 13-14

For Sale—Great Bargain

Nine 8 horse power Vertical Alberta Boilers. Two 8 h.p. and two 6 h.p. Ingeco Gasoline Engines. All New.

MARSH-CAPRON MFG. CO.,
11 S. La Salle Street,
13-14-15 Chicago, Ill.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Dominion Government Office Building, Ottawa," will be received at this office until 4 p.m., on **Tuesday, April 2, 1918**, for the construction of a Dominion Government Office Building, O'Connor Street, Ottawa, Ont."

Plans and forms of contract can be seen and specification and forms of tender obtained at the offices of the Chief Architect, Department of Public Works, Ottawa, the Overseer of Dominion Bldgs., Central Post Office, Montreal, and the Clerk of Works, Postal Station "F," Toronto, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and the place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for the sum of seventy-five thousand dollars ($75,000), which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

Note.—Blue prints can be obtained at the office of the Chief Architect, Department of Public Works, by depositing an accepted bank cheque for the sum of $50, made payable to the order of the Honourable the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,

R. C. DESROCHERS,
Secretary.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 12-13

FOR SALE

By County of Welland

6--4-yard Dump Cars.
2 -Gasoline Tractors.
1 -Crusher Bin.

Machinery can be seen at Welland by calling on the County Road Superintendent, W. W. Brookfield.

Tenders will be received up to twelve o'clock noon on **Monday, April 1st, 1918.** Must be in the Clerk's hands by that date.

ROBERT COOPER,
11-13 County Clerk.

Roof Trusses, Etc.

For Sale--Four Roof Trusses, each thirty feet long, ten feet high at one end, eight feet six inches at the other end. Angle iron construction and well braced. Also 19 Cast Iron Columns from sixteen feet long to seventeen feet seven inches. Good heavy segment.

WOODSIDE BROS,.
12-17 Port Arthur, Ont.

(Public Advertisement)

Tenders Wanted for Electric Wire and Cable

Parliament Buildings, Ottawa

Sealed tenders will be received by the undersigned until noon, April 11, 1918, for the Electric Wire and Cable required in the reconstruction of the above building.

All tenders to be based on the supplying and delivering on the site of the quantities of the schedule of materials for Electric Wire and Cable in strict conformity with the specifications and the samples submitted and to the satisfaction of the Architect.

Deliveries to commence by July 1, 1918, and to continue as directed in such quantities as to ensure complete delivery by August 31, 1918.

The schedule of materials, specification and other information required can be obtained at the office of P. Lyall & Sons Construction Company, Limited, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, for a sum not less than ten (10 p.c.) per cent. of the amount of the tender, which will be forfeited if the parties tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender is not accepted, the cheque will be returned.

Payments for material will be made monthly.

The lowest or any tender not necessarily accepted.

Envelopes containing tenders to be marked "Tenders on Electric Wire and Cable" and addressed to the undersigned.

JOHN A. PEARSON, Architect.
J. O. MARCHAND, Associate.
Centre Block, Parliament Buildings,
Ottawa. 12-13

Stone Crusher Wanted

Wanted to rent, for season of 1918, a complete portable stone crushing outfit, size of crusher about 10 by 16. Apply, giving terms, to Box 693, Contract Record, Toronto. 9-t.f.

Wanted to Buy or Lease

STEAM SHOVEL

A one-half yard, or larger Steam Shovel, suitable for light work. Write or wire The Ross Navigation Company, Limited, The Pas, Man.
13 14

Locomotive Crane For Sale

20 ton 8 wheel Browning, 46 ft. boom with 14 ft. extension. Good Condition. Immediate delivery.

The A. R. Williams Machinery Co., Ltd.,
10-t.f. 64-66 Front St. West,
Toronto, Ont.

WANTED

2 Locomotives—12 to 15 tons, 36 in. gauge.

15—4 yard dump cars—36 in. gauge.

1—Travelling derrick on low broad wheels.

70 Tons—40 lb. re-laying rails.

In writing give full particulars.

McDougal Bros.

Besserer Street, - OTTAWA

11-12 13

SITUATION VACANT

CEMENT CHEMIST WANTED about April 20th. Must be in a position to take complete charge of laboratory and make good cement. State age, experience and salary expected. Box 709, Contract Record, Toronto. 13-14

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Joint Committee Doing Valuable War Work

THE annual meeting of the Joint Committee of Technical Organizations, Ontario Branch, was held in the Chemistry and Mining Building, University of Toronto, on March 25, with an attendance of some two hundred technical men. The features were Chairman Alfred Burton's report, and addresses by Col. David Carnegie, managing director and ordnance adviser Imperial Munitions Board, and Mr. W. E. Segsworth, Administrator for Canada of the Vocational Branch of the Invalided Soldiers' Commission.

This Committee, formed some eighteen months ago for the purpose of co-relating the activities of engineers and technical men in general in furtherance of the Empire's war aims, is shown in the Chairman's address to have achieved very gratifying results. An example of this is their work on inventions for the Imperial Munitions Board, in connection with which Col. Carnegie, in his address, spoke in the highest terms of praise and appreciation. The Chairman's report is given elsewhere in this issue and the addresses of Col. Carnegie and Mr. Segsworth, both of unusual interest and value, we hope to be able to give our readers at an early date.

The chairman for the ensuing year is Mr. G. A. McCarthy. The elected members are as follows: Canadian Mining Institute (Toronto branch), W. E. Segsworth; Canadian Society of Civil Engineers (Toronto branch), L. M. Arkley; Association of Ontario Land Surveyors, R. R. Grant; Society of Chemical Industry (Canadian section), E. P. Mathewson; Engineering Alumni Association, University of Toronto, H. G. Acres; Royal Canadian Institute, Harry Jewell; Canadian Engineers, District No. 2, Major L. L. Anthes; American Society of Mechanical Engineers (Ontario section), C. B. Hamilton, Jr.; American Institute of Electrical Engineers (Toronto section), W. G. Gordon; Institution of Electrical Engineers, S. L. B. Lines; Ontario Association of Architects, Toronto Chapter, R. K. Shepard; Engineering Alumni Association, Queen's University, Alex. C. Longwell; Canadian Manufacturers' Association, G. M. Murray; Engineers' Club of Toronto, W. A. Bucke; A. Burton, W. P. Dobson.

Engineers Point the Way for Solution of Fuel Problems

THE "Fuel Discussion" Convention of the Canadian Society of Civil Engineers, recently held in Toronto, approached the problem from every angle, and it is to be hoped that official action will follow immediately. It was pointed out at these meetings that the fuel and water power resources of Canada were of enormous extent, and in view of this it was incumbent upon the Canadian people to develop these resources in a rational scientific manner and make them available for use as soon as possible. In the meantime as far as Canada is concerned, and particularly the middle portion of the country, we were still dependent upon the good will of the United States for fuel supplies.

Of those fields which offer relief from the present situation wood stands out as the one source of supply from which immediate help may be expected, and consequently it is imperative that aggressive action be taken by the various Ontario municipalities to provide a supply of wood for domestic purposes for the coming winter.

The art of manufacturing and using peat fuel has been well advanced in other countries so that there is little doubt that air dried machine peat will, in the near future, be used to some extent to take the place of coal. Peat is particularly well suited for gas producers, more especially those of the by-product type. When burnt under boilers the steam value of peat is about one-half that of good coal. A further relief in the fuel situation is promised by the industrial evolution of the carbonization of coking coals which has led to the employment of high temperatures which give strong metallurgical coke and higher yields of city gas. A commendable reaction has set in towards low temperature and hig tar yields, as tar oils are increasingly needed for motor fuels. A systematic investigation of lignites now in progress in the fuel testing laboratories at Ottawa shows that a valuable fuel of high heating value can be made by suitably controlled carbonization followed by briquetting. Carbonized peat or peat coke is a high grade fuel which need not be briquetted.

A rational development of Canada's coal resources would indicate that on account of its importance and exhaustible nature coal should be only used for the purpose for which best suited. Suggestions as to its development were: 1. Substitution of coke for anthracite; 2. the introduction of by-product coke ovens, and the transformation of gas plants to include more thorough by-product recovery; 3. Carbonization and briquetting of low grade fuels; 4. the use of pulverized coal as a locomotive fuel; 5. the elimination of waste in mining; 6. greater use of Western coals to replace imported coal in the area west of Port Arthur, which includes avoiding the use of fuel requiring a long haul wherever it is possible to procure a suitable substitute requiring only a short haul; 7. by the earliest exploitation of our own resources to aim at limiting the necessity for importing fuel from other countries.

While oil fuel is an ideal fuel for all purposes, it will never be a competitor of coal to any extent in this country, unless the production of oil is materially increased, but it will always be a splendid supplementary fuel to coal.

The possibilities of the relief of fuel consumption in Canadian industries by the increased use of hydro-electric energy lie: (a) in the limitation in existing plants of the use of coal for heating purposes only, wherever hydro-electric power is available—such limitation having as its object the restriction of the use of unreplacable material by power derived from natural sources which do not suffer depletion by use, and (b) the establishment of a national policy which will ensure factories in the future locating at points where their demands for raw material and power may be met by the most economical use of such materials and facilities as are indispensable for their operation.

Central heating as a means of conserving fuel was suggested, the system being to burn coal at a central point and pipe the heat to those who would otherwise burn coal. This heat can be piped as high or low pressure steam or hot water. Such a system if applied to Toronto, covering the business section, would save in coal $100,000 per year.

Railway electrification offers great theoretical promise of conservation by saving coal and by increasing the capacity of tracks and terminals of congested railway districts. If the energy for railway electrification is obtained from water power all the coal otherwise consumed by steam locomotives would be saved. An electric locomotive does three and a half times as much work in ton miles as a steam locomotive. This question is, however, a highly specialized one—economic, financial and engineering—while the high cost of apparatus due to labor and other conditions prohibit the carrying on of railway electrification at the present time on a wholesale scale.

As to the general heating of buildings by electricity it was shown that it is economically out of the question to-day and its general use in the future is very remote. Approximately two million horse power would be required to electrically heat Toronto's buildings housing a population of five hundred thousand people. Heat from anthracite coal is normally one-fourth to one-fifth the cost of heat from electricity. At existing prices one cent will purchase the following units of heat applied to buildings—anthracite coal, 14,300 units; bituminous coal, 21,000 units; oil, 7,750 units; electricity, 4,200 units. Electric heaters now operate at one hundred per cent. efficiency, and the marvellous inventions frequently announced in the daily press cannot remove them. The general electric heating of buildings should not be considered, as, at the present time, the power consumed should be used for munitions and for industrial purposes.

Water Power Development

Canada is recognized as one of the great water power countries in the world. No country enjoys to a greater degree the benefits of cheap, dependable hydro power, and no country has had that benefit more universally applied for municipal, industrial and domestic use. Water power must take a very prominent part in the best use if the varied fuel power resources of Canada is to be achieved. There must be evolved a national water-fuel-power policy which will realize the best possible co-ordinated and concentrated development for the use of all the resources of the Dominion. Cheap power promises to be one of the country's greatest assets in the post bellum industrial rivalry of nations for world trade. Our great fuel reserves, supported by our water power resources represent a sure source of cheap power, and should guarantee Canada her share of world trade if these resources are utilized to their maximum possible advantage.

A number of the papers presented before the Convention are reproduced in this issue, in full, with others in extract. A study of the contents of these papers will amply repay any of our readers who desire to lend their assistance in conserving our fuel.

Building Permits Show Falling Off

THE value of building permits issued in 35 cities showed a decrease during February as compared with the previous month, the total value of permits falling from $1,562,637 in January to $901,933 in February, a decline of $660,704, or 42.2 per cent. Saskatchewan and Manitoba recorded increases, while in Nova Scotia, also, there was an inconsiderable gain. As compared with the corresponding month of 1917, there was a decrease of 46.4 per cent., the value for February, 1917, being $1,682,495.

Estimated Cost of Building Work as Indicated by Building Permits in 35 Cities

City	February 1918	February 1917	February, 1918, compared with February, 1917 Increase (*)	Decrease (†)
Nova Scotia	**$71,584**	**$90,450**	**†$18,866**	**† 20 86**
Halifax	68,075	88,535	† 20,460	† 23 11
Sydney	3,509	1,915	* 1,594	* 83.24
New Brunswick	......	**88,475**	**† 88,475**	......
Moncton	......	2,175	† 2,175	......
St. John	......	86,300	† 86,300	......
Quebec	**134,692**	**563,330**	**†428,638**	**† 76.09**
Maisonneuve	......	500	† 500	......
Montreal	77,045	402,565	†325,520	† 80 86
Quebec	25,147	145,725	†120,578	† 82.74
Sherbrooke	......	9,914	† 9,940	......
Three Rivers	17,000	2,700	* 14,300	* 529 63
Westmount	15,500	1,900	* 13,600	* 715.79
Ontario	**492,492**	**774,435**	**†281,943**	**† 36.46**
Brantford	10,000	5,815	* 4,185	* 71.97
Fort William	......	150	† 150	......
Guelph	2,800	3,200	† 400	† 12.50
Hamilton	65,890	42,610	* 23,280	* 54 63
Kingston	......	....	......	......
Kitchener	425	2,775	† 2,350	† 84.68
London	16,560	18,305	† 1,745	† 9.53
Ottawa	15,800	26,500	† 10,700	† 40.38
Peterborough	1,230	13,425	† 12,195	† 90.84
Port Arthur	530	1,125	† 595	† 52.89
Stratford	575	11,305	† 10,730	† 94.91
St. Catharines	7,675	13,508	† 5,833	† 41.70
St. Thomas	550	2,000	† 1,450	† 72 50
Toronto	347,282	573,517	†226,235	† 29.44
Windsor	23,175	60,200	† 37,025	† 61.40
Manitoba	**54,900**	**36,350**	*** 18,550**	*** 51.03**
Brandon	250	24,000	† 23,750	† 98.96
Winnipeg	54,650	12,350	* 42,300	* 342.51
Saskatchewan	**29,225**	**17,255**	*** 11,970**	*** 69.37**
Moose Jaw	18,600	2,600	* 16,000	* 615.38
Regina	3,650	13,005	† 9,355	† 71.93
Saskatoon	6,975	1,650	* 5,325	* 322 73
Alberta	**47,850**	**8,000**	*** 39,850**	*** 496.18**
Calgary	32,200	4,500	* 27,700	* 615.56
Edmonton	15,650	3,500	* 12,150	* 347.14
British Columbia	**71,190**	**104,200**	**† 33,010**	**† 31.68**
New Westminster ...	3,900	6,520	† 2,620	† 40 18
Vancouver	55,415	96,780	† 41,365	† 42 74
Victoria	11,875	900	* 10,975	*1,219.44
Total (35 cities) ...	**$901,933**	**$1,682,495***	**†$780,562**	**† [illegible]**

Placing Superstructure on C. P. R. North Toronto Bridges

Fifty Two-Ton Pre-cast Cement Beams are Handled with Locomotive Cranes and Interesting Travelling Device

FOR several years the C. P. R. have been carrying out a series of improvements in the North Toronto subdivision of its through line. This line into the city is several miles shorter, and has considerably lower grades than the line running into the Union Station. The fact that a large portion of the population of Toronto are residing closer to the North Toronto than the Union Station and the congestion at the terminal station had a great deal to do with the decision to make these improvements. The C. P. R. and C. N. R. Companies built the North Toronto station and doubled and elevated the trackage to the West Toronto station. Contract Record of December 29, 1915, and July 12 ,1916, had articles fully describing this work.

At the present time extensive improvements are being carried out on the line from Toronto to Leaside. At miles 0.9 and 1.8, measured from Leaside, two bridges occur. These were originally single track, trestle with plate girder, steel structures. The bridge at mileage 1,8 crosses what is known as Reservoir Ravine. The bridge at 0.9 crosses the Belt Line ravine. A number of designs for this work were considered. A steel addition to the old steel bridge to widen it out was first thought of and finally discarded. The plan of entirely new steel structures were also discarded, it was stated, owing to the high cost of steel. Several reinforced concrete designs were considered and plans for an arch bridge discarded when tests showed that the clay bottom petered out and became a near quicksand. Reinforced concrete bridges of quite unusual design was eventually decided upon. They are of a reinforced concrete trestle type resting on continuous footings under each bent. The bents contain four posts (three in the Belt Line bridge) tied together with the outside posts battered. The trestle spans are 34 feet and the spans between the trestles are 36 feet.

Probably the most unusual feature of these bridges is the pre-cast I-beams which form the decks. In fact, the whole of the superstructure carried on the reinforced concrete towers is pre-cast before being set in place. An article appearing in the Contract Record on page 917 of the November 7, 1917, issue, describes fully the manufacture of the deck slabs. Sixty-six T-beam units weighing approximately 52 tons each will form the deck slab of the bridge over Reservoir Ravine. The curb sections, handrail posts and sidewalk slab have all been pre-cast and all that remains is the setting of these units to complete the structure.

The contractors for the reinforced concrete work for the bridge over Reservoir Ravine were Wells and Gray, Limited, Toronto. The contract for the construction of the bridge over the Belt Line Ravine was carried out by the Dominion Construction Company of Toronto, who also erected the temporary trestle work at this point. The two steel bridges were removed by James Finley, structural contractor, of Tweed, Ont. The erection of the temporary trestle over the Reservoir Ravine was carried out by the C. P. R. forces.

Belt Line Ravine Bridge

The bridge which is being constructed over the Belt Line Ravine is a double track structure composed of five reinforced concrete towers of two bents each supported on continuous footings. The superstructure consists of 44 pre-cast concrete track slabs, 90 sidewalk slabs and 96 handrail posts. The concrete work of the new bridge is complete with the exception of rubbing down the concrete, which will probably be done after the superstructure is placed. It is stated that the contractors will use a cup-stone set on a spindle and driven direct by a small electric motor for the polishing of the exposed surfaces.

James Finley, of Tweed, Ont., has the contract for placing the superstructure, the units of which were cast some months ago by the Dominion Construction Company as part of their contract. His plant consists of two locomotive cranes, a number of hydraulic jacks and two sets of quadruple block and tackle. The locomotive cranes go down the mainline to the storage ground, which is about half a mile from the bridge, for the deck slabs. The cranes, one at each end, pick up the beam and set it on two railroad trucks placed about eight feet from either end of the slab. The forward truck is fitted with a draw bar and the heavy 100-ton crane engages this and draws the beam to the

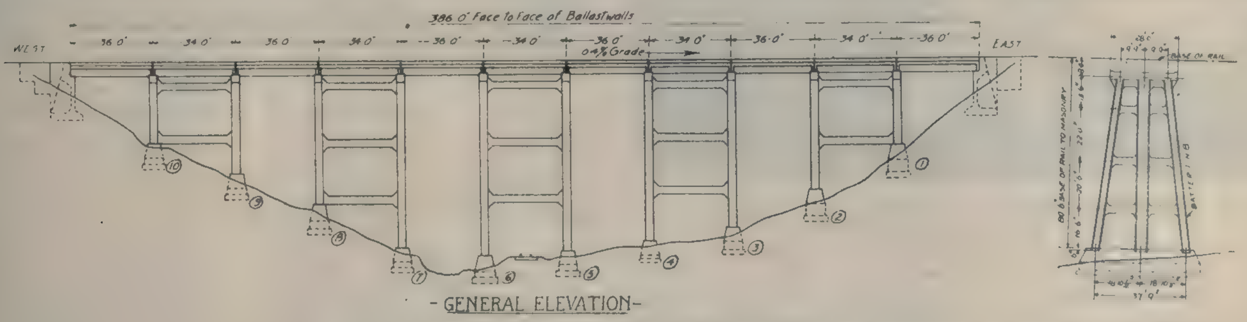


Fig. 1.—Elevation of Belt Line bridge and of typical bent.

bridge site, where it is shunted onto a switch line running to the bridge trestles.

The tackle used for picking up the beam consists of two 12-inch I-beam sections fabricated like a box girder with two web pieces about 14 inches wide. A heavy clevice is fastened to the center of this to engage the clevice on the crane block. Two rods 1½ inches in diameter and threaded on each end pass through the tackle and through the flanges of the beam close to the stem of the T-beam section and are fastened by means of nuts to a heavy plate on the under side. The apparatus for carrying the beams over the trestles is rather unique. It looks very much like two bridge trusses built of wood, with the lateral bracing and upper cross timbers removed. At the forward end the posts are extended to rest on the reinforced caps of the bridge bents. The other end rests on a heavy piece of timber, to which the trusses are bolted.

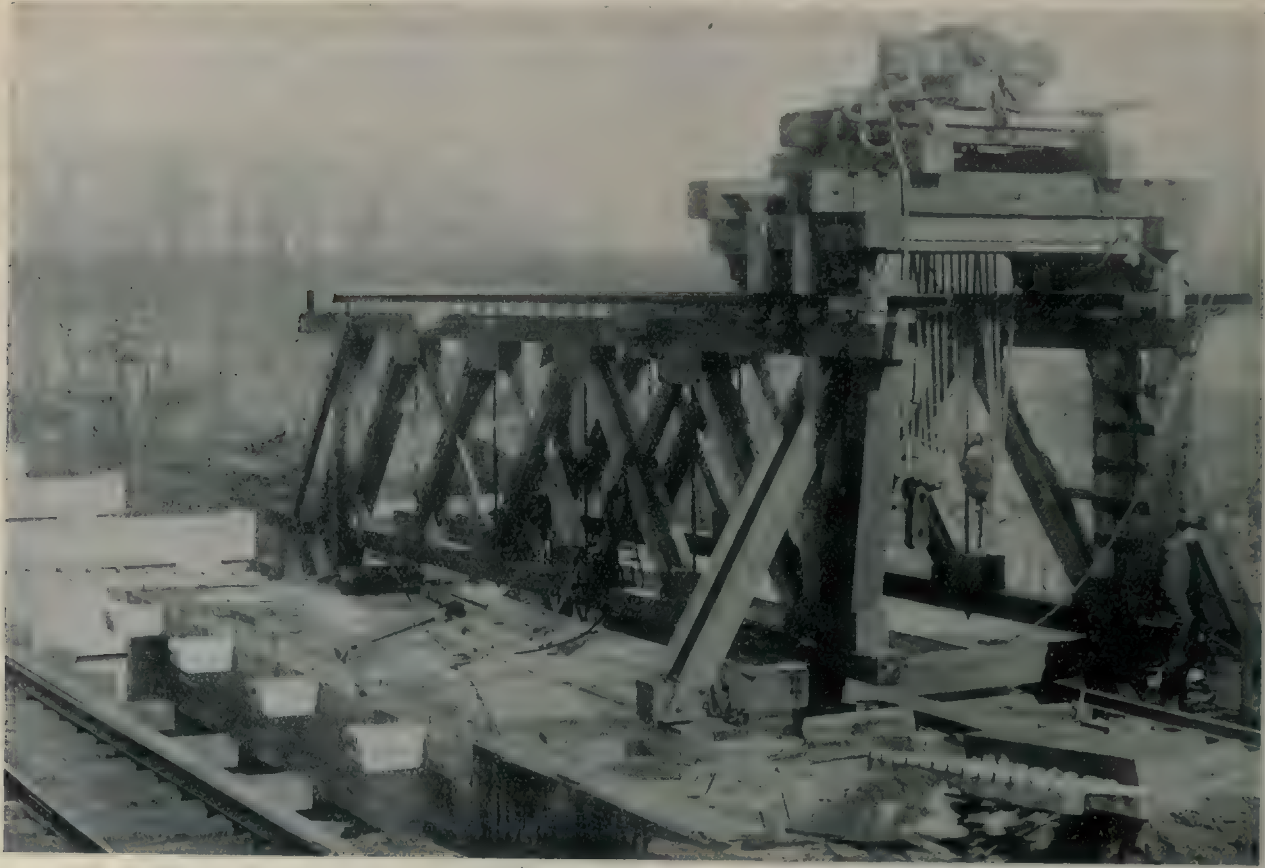


Fig. 2.—Detailed view of erecting trestle and traveler. Note the outside supports to the trusses, and the heavy quadruple blocks.

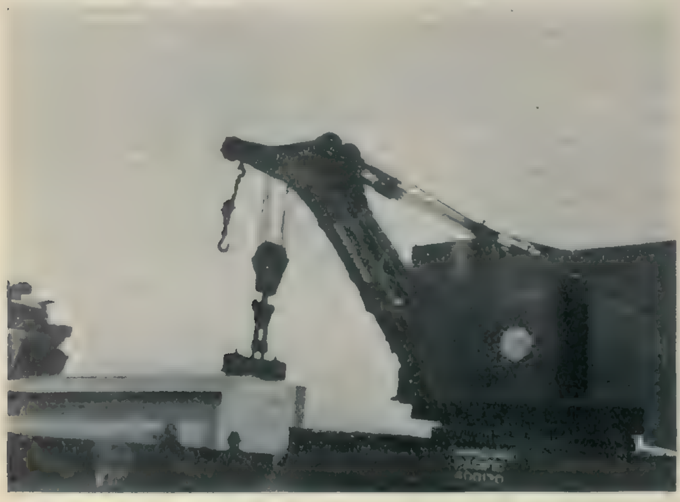


Fig. 3.—Showing 100 ton locomotive crane picking up end of beam to permit removal of temporary blocking.

Two sections of rail are laid along the top chord and superimposed on these rails is a traveler. The traveler is constructed of dimension timber and is fitted with two trucks with double flanged wheels. Two sets of quadruple blocks are fastened to the traveler and are used to carry the end of the beam. A section of timber is bolted to the top of this apparatus, to which the workmen snub the tackle rope when they lower the beam to its place.

The sequence of operations in placing a beam is as follows: The crane pushes the beam, on its trucks, along the spur until the forward end comes under the traveler. The blocks are then fastened to the beam using tackle similar to that previously described. The crane then picks up its end clear of the trucks and, afteh the beam is blocked in this position, picks up the rear truck and places it out of the way. Again engaging the beam, the crane picks up its end, raising it clear of the blocking, which is then removed, and the beam is lowered until the end touches the railway ties. By lowering the rear end, the beam teeters on the forward truck and the front end rises. The rope tackle is then tightened up and snubbed, and the crane, by raising its end, transfers the weight off the forward truck onto the traveler. The forward truck is then run back and, after the beam is again blocked up, is removed by the crane. The beam is now held in the air, as shown in Fig. 4, one end being carried by the crane, the other by the tackle mounted on the truck of the traveller. A piece of 6 by 6 inch timber is temporarily placed between the traveler and the crane tackle and a second piece between the beam and the crane itself. The crane now moves forward, pushing the beam and traveler ahead of it to the desired position. The beam is then lowered into place. The whole operation at the bridge site takes about 35 minutes.

The operation of moving the traveler forward to the next truss (see Fig. 6 for details of this truss) bent is easily performed. One of the cranes, operating on the existing line, which is parallel to the bridge, picks up the rear end of the traveler truss; the other crane picke up the rear end of this truss and both cranes move forward, carrying the truss to the desired position. After the beams are placed they will be grouted and waterproofed, expansion joints being left at the ends of the beams. The tracks will then be laid in ballast.

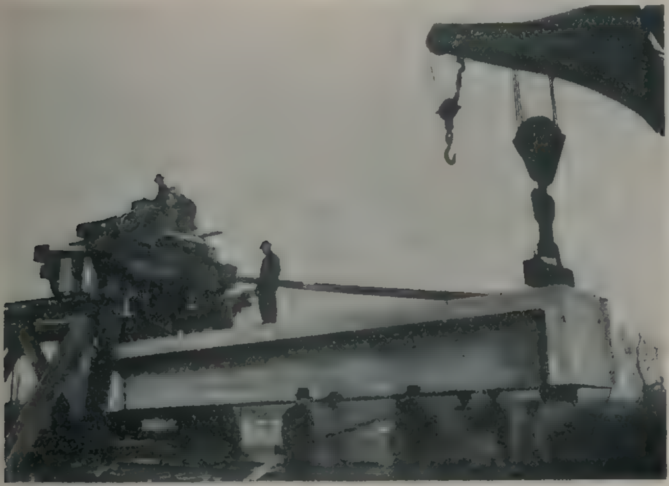


Fig. 4.—Showing the beam supported by the crane and traveler.

The work is being executed under the supervision of Mr. J. M. R. Fairbairn, assistant chief engineer of the C. P. R. The design was prepared under the supervision of Mr. P. B. Motley, Engineer of Bridges, Can. Pac. Ry. Co. Mr. J. H. Barber, with A. H. Munson as his assistant, is the engineer in charge of the work.

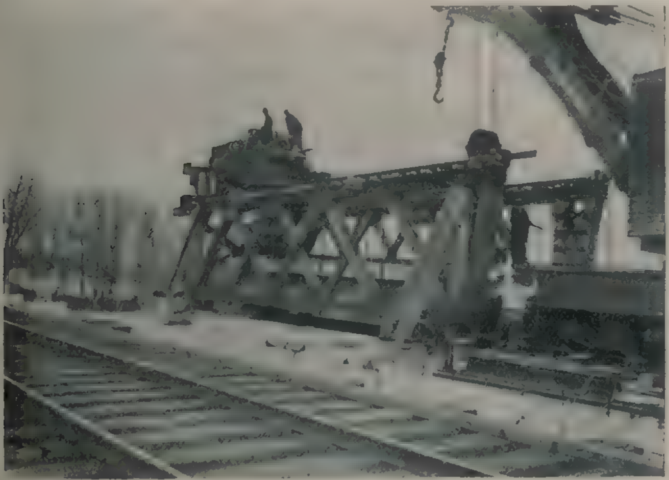


Fig. 5.--Lowering beam to its final position.

There are, approximately, 7,500 parts in the American war truck, which weighs complete just over four tons, and is propelled by a 58 horse-power engine, running at 1,350 revolutions per minute.

The efficiency of manilla rope connections and fastenings in terms of percentages of the tested strength of the new rope has been found by careful experiment to be 90 per cent. for an eye spliced over an iron thimble, 80 per cent. for a short splice, 65 per cent. for a timber hitch, slip knot, or clove hitch, 50 per cent. for square knot, weaver knot, or sheet bend, and 45 per cent. for a Flemish loop or overhand knot.

When vertical timbers like piles, posts, and other supports are partly embedded in the ground they are likely to fail rapidily by decay at ground level, while the timber above and below that point remains sound. It is said that the decay can be greatly retarded and the life of the structure much prolonged by enclosing the timbers just above and below the ground level by sleeves filled with common salt.

Large piles of coal in storage are often in serious danger of spontaneous combustion. The height, to prevent this, should never be more than 20 ft. and sometimes not more than 12 ft. Care should be taken to limit the horizontal area of the piles in order to make them accessible for inspection and segregation to provide for their proper draining, and to avoid the storage in them of different kinds of coal, and of coal containing large percentages of sulphur. The piles should be ventilated with horizontal flues through the lower parts and should periodically be sounded for temperature.

Eminent Engineer Passes Away

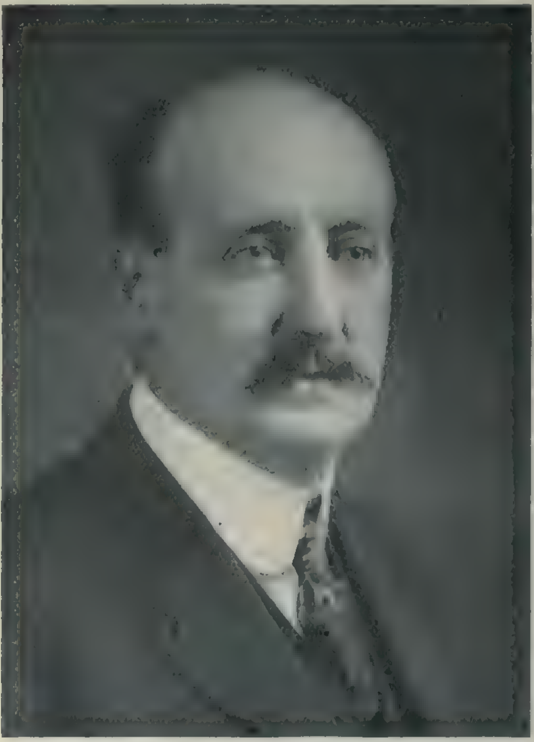
In the person of Sir Collingwood Schreiber, who died on March 23. at his home in Ottawa, aged 87, Canada has lost one of her greatest engineers and railroad builders. For sixty years the late Sir Collingwood had been actively associated with the building and development of both publicly and privately-owned railways in this country, and for his outstanding services in connection with the construction of government lines he was knighted in 1915. He was born in England and came to Canada as a young man, in 1852. He first secured a position on the engineering staff of the Toronto and Hamilton Railway, staying with this road until 1856. Having demonstrated his capabilities as an engineer, he was then taken into partnership in the engineering firm of Fleming, Ridout & Schreiber, of Toronto, thus becoming associated with Sir Sandford Fleming. He remained in practice until 1860, when he superintended the construction of the Northern Railway now a part of the northern division of the Grand Trunk—till the year 1863. During the four years following he was engaged in the construction of the Pictou Railway, in Nova Scotia, and then assisted in laying out the Temiscouata section of the Intercolonial Railway. Later he built and became superintending engineer of the Eastern Extension Line, now part of the Intercolonial, and in 1873 was appointed chief engineer and general manager of all government railways in operation. Seven years afterwards Sir Collingwood also was appointed as chief engineer of the C.P.R., succeeding his old partner, Sir Sandford Fleming. He retained his position on the government railways and with the C.P.R. until 1892, when he became chief engineer of the Department of Railways and Canals. Later he was appointed deputy minister of the department, and continued to administer this office until 1905. In that year he became general consulting engineer of the Dominion Government and chief engineer of the western division of the National Transcontinental Railway. Since that time his chief work has been the inspection of the construction of the Grand Trunk Pacific.

Can. Soc. C. E. Hold Professional Meeting

Discuss Fuel Situation in all its Phases—Valuable Data Presented on which to Base Action — Wood Immediately Available — Vast Areas of Peat Bogs—Water Powers Our Greatest Asset

MEMBERS of the Canadian Society of Civil Engineers foregathered at the headquarters of the Toronto branch, 96 King Street West, on Tuesday morning, March 26, for the first general professional meeting of the organization.

Arrangements had been made for the delegates to visit the plants of Canadian Aeroplanes, Limited, on Dufferin Street, or the plant of British Forgings, Limited, on Cherry Street. Some twenty of the members elected to go to the British Forgings and the balance visited the aeroplane plant. A special car left the club rooms at 10 o'clock, taking the members to the aeroplane factory site and returning at noon. The Canadian Aeroplane plant occupies ten acres of land, four of which are covered with buildings. Some idea of the organization may be gathered from the fact that they manufactured 370 machines during the month of February. The party was broken up into small sections and conducted through the plant by officials of the company. They first inspected the machine shop and were shown the different operations of manufacture of the component parts of the fusilage and were later conducted through the assembling room, where machines in different stages of completion were viewed.



Mr. H. H. Vaughan, President of the Canadian Society of Civil Engineers.

The members met in Convention in the afternoon in the Physics Building of the University of Toronto, with Mr. H. H. Vaughan, President of the Society, in the chair. The Premier of the Province, Sir William Hearst, was present, welcomed the members of the Society to their initial general professional meeting, and remarked upon the fact that the object of the meeting was the discussion of the fuel problem, which was also having the serious consideration of himself and his associates. The government was taking important and aggressive steps to deal with the situation. Although it was uncomfortable to have to depend so much upon a foreign country, Mr. Hearst was glad that we were depending upon an ally. He hoped and believed that the Union Jack and the Stars and Stripes would float together as an emblem of democracy and freedom. The war, with its resultant effects on labor and transportation, has brought about abnormal conditions with regard to the fuel question, but the end of the war will not be a solution of our problems and we must plan for all time to come. Canada has tremendous water powers, great deposits of peat, but no real deposits of anthracite.

Sir William gave a brief resume of the Fuel Act, outlining the duties of the fuel controllers and the purpose of the peat testing laboratories. It had been determined that it is impossible to develop our peat resources to a sufficient extent to cope with the conditions during the following year, and that we will have to rely to a great extent on the wood supply.

In conclusion Sir William said that we were passing through trying days, but that he had no fear of the result. The chastening that we were at present receiving would all be of future benefit to us and if we had been lax in our duty at home, the men at the front were not.

The Fuels of Canada

Mr. B. F. Haanel re-read a paper presented last January at the annual meeting of the society. This paper was printed in full in the January 30 issue of the Contract Record.

Discussion

Professor Arkley, of the Mechanical Engineering Department of the University of Toronto, introduced the discussion on Mr. Haanel's paper. How to save at least 1,000,000 tons of coal per year in Canada by efficient operation of heating plants was the pith of Professor Arkley's remarks. In burning one pound of coal 11½ pounds of air have to pass through the boiler to supply enough oxygen for the complete combustion of the coal. In practice it is customary to supply sufficient area in the boiler tubes to allow for 24 or 25 pounds of air per pound of coal. The principal loss of heat is through the escape up the flues, but another of the heavy losses is through the incomplete combustion of the gases. To obtain the best results the percentage of CO_2 going up the flue should be a maximum. The best equivalent of a pound of coal burned to CO_2 is 14,500 B.t.u.'s, but if only burned to CO it is 4,500 B.t.u.'s, so it is obvious that if the carbon is burnt to carbon dioxide the resulting heat is much more than if it

A group of engineers attending fuel discussion of the Canadian Society of Civil Engineers.

were only to form carbon monoxide. The causes of high flue gas temperature are soot and scale on the boiler tubes, holes burnt in the baffle plates, allowing direct passage of gas to the flues and overload on the boilers. A low percentage of CO_2 in the flue gases is caused by leaks in the boiler setting, having too thin a fire or having too strong a draft.

Professor Arkley quoted figures to show that a little extra education of the fireman in respect to these matters could easily result in a saving of 10 per cent. of the total heat value of the coal consumed. As there are approximately 10,000,000 tons of coal burnt annually for power purposes only, if a saving of 10 per cent. can be effected by the more efficient operation of boilers, 1,000,000 tons are saved in power plants alone. If the same argument is applied to heating instsallation the saving would be considerably over one million tons. It was suggested that firemen be instructed how to gain the best results in flue gases, be given an apparatus to measure the percentage of CO and CO_2, and, as an encouragement, given a bonus based on the percentage of carbon dioxide found in the flue gases.

Fuel from a Transportation Standpoint

By W. N. Neal*

Mr. Neal's paper briefly outlined the situation regarding the importation and distribution of coal before the war and at the present time under greatly changed conditions. As emphasizing the importance of the coal carrying trade, he pointed out that the weight of bituminous coal alone carried in a year is just a trifle less than the weight of all the grain produced in the Dominion.

The speaker divided the country roughly into five districts according to the fuel situation in each. District No. 1 included from Halifax, roughly, to Montreal; this was supplied formerly with bituminous coal from Nova Scotia and Cape Breton, partly by rail, but chiefly by boat. For example, in 1913 two and one-quarter million tons were distributed by two companies down the St. Lawrence River. District No. 2 covered the territory, roughly, from Quebec City west to Windsor and Sarnia and north to Sudbury, North Bay, and Cochrane—the great coal importing area of Canada. The coal came in by rail, by water, and by car ferry. In District No. 3 was included all the north shore of Lake Superior west of the eastern boundary of Manitoba. The chief distributing points are Port Arthur and Fort William, which receive their supplies of coal by boat. District No. 4 includes practically the three provinces of Manitoba, Saskatchewan, and Alberta. District No. 5 takes in the western slope of British Columbia. In this area the railways use coal and oil fuel.

Difficult Problems Faced the Railroads

The situation at the present time is that a very large percentage of the steamers formerly used for coal carrying are now utilized for war purposes. In District No. 1, for instance, the two and one-quarter million tons distributed by boat are now carried by rail. In addition, this district has been extended further west as far as Ottawa and Cornwall, thus throwing a double load upon the railways. Districts Nos. 2 and 3 have been affected very similarly; not only has there been a considerable falling off of water carriage, but, in addition, there has been the congestion of the United States roads. Here again the entire burden has been thrown upon the railways. They met the emergency by (a) building more coal cars, (b) converting sand and gravel cars for coal use, (c) enforcing economy in their own use of coal, (d) using box cars for coal carrying, and (e) by trying to move as much coal as possible in the summer. In District No. 4 the question is now being discussed whether these provinces might not in the very near future look after their own needs, and it is hoped that by the winter of 1919-20 they may be almost self-supporting. Difficulties in the way are labor troubles and lack of storage facilities for lignite coal. Conditions in District No. 2 have not changed to any extent.

In conclusion, Mr. Neal spoke of the special steps the railways have taken to economize in their own use of coal. These include a cutting off passenger trains to the extent of a total yearly mileage of 12,000,000 miles—the equivalent of 600,000 tons of coal. Parlor and observation cars have been eliminated; fewer sleepers have been attached; the speed of all trains has been reduced to the point where maximum efficiency is obtained from the fuel standpoint, and special trains and private cars have been eliminated. In the department of freight a campaign for heavier loading has resulted in great savings, the speaker quoting a case where the average load per car had risen from 26.4 tons to 32.3 tons during the past year. The saving from this improvement alone was 7,300 tons of coal per month, in addition to which there was the saving of the time of 11 locomotives, 55 engine and trainmen, besides shop men, yard men, car checkers, repair men, etc. In the actual firing of the engines further economies have also been effected, and expert firemen are periodically sent out to instruct those less experienced.

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*General secretary of the Canadian Railway Association for National Defence, Montreal, Que.

As indicating the importance of fuel traffic, Mr. Neal pointed out that the amount of fuel hauled both for themselves and for the public together amount to approximately 25,000,000 tons—over one-fifth of the total freight tonnage carried by all the railways. It required the services of 29,948 trains of 23 cars per train, or the exclusive services for the whole year of about 1,000 freight engines and 23,000 freight cars.

The Rational Development of Canada's Coal Resources

By W. J. Dick*

Mr. Dick's paper pointed first to the value of coal by enumerating the purposes for which it has been used in the present war; (1) As a source of power; (2) metallurgical purposes; (3) as a source of tri-nitro-toluene; (4) as a source of picric acid; (5) as a source of ammonia for explosives, nitric acid and fertilizers; (6) for the production of benzol.

The world's estimated reserves of coal of all kinds available within a depth of 6,000 feet from the surface aggregates 7,397,553 tons, or approximately 5,000 times the world's present annual consumption of coal. Of this reserve, 6.71 per cent. is anthracite (over 80 per cent. in Asia, mainly in China) and 52.7 per cent. includes lignites and brown coals. In geographical distribution, 68 per cent. of the total is found in North America, 17.3 in Asia, 10.6 per cent. in Europe, 2.3 per cent. in Oceania and 8 per cent. in Africa. The distribution by countries is: Canada, 16.4 per cent.; United States, 51.8 per cent.; China, 13.5 per cent.; Germany, 5.7 per cent.; Great Britain, 2.6 per cent.; Siberia, 2.4 per cent.; Australia, 2.2 per cent.; and 5.4 per cent. distributed in small deposits among smaller countries. The coal deposits of Canada are thus second only to those of the United States. The known area in Canada underlaid by workable coal is estimated at 111,168 square miles, containing 300,000 million tons of coal. This is distributed roughly as follows:

(1) The eastern division, containing the bituminous coals of Nova Scotia and New Brunswick.

(2) The central or interior divisions, containing the lignites of Manitoba and Saskatchewan and the bituminous and semi-anthracite deposits of Alberta and the Rocky Mountains.

(3) The Pacific Coast division, including the bituminous fields of Vancouver Island, the bituminous and semi-anthracite deposits of Queen Charlotte Island and the British Columbia interior, and the lignites of the Yukon.

(4) The northern division, containing the low grade qualities of the Arctic Mackenzie basin.

The total coal production of Canada amounts to approximately 15 million tons per year; the imports are two or three million tons in excess of this. In view of the fact that we have no guarantee that the import of coal from the United States will be continued, it is necessary that our own resources should be developed. In discussing this side of the question, Mr. Dick resolved the problems under the following headings: (1) Domestic fuel problem in Central Canada; (2) railway fuel problem in Central Canada; (3) domestic fuel problem in the prairie provinces; (4) cheap power problem in prairie provinces; (5) railway fuel problem in forest areas in British Columbia and Alberta.

1. Domestic Fuel Problem in Central Canada

It is natural to expect that the price of imported coal will increase year by year. As an alternative for the present imported anthracite, there is little chance of importing bituminous coal from Eastern Canada, both on account of its cost and its limited supply. We must therefore in the meantime obtain bituminous coal from the United States. For greater economies, central heating plants are suggested which will produce power and utilize the exhaust steam for domestic heating. However, the more promising solution is in the use of coke. It is suggested that each city might establish a plant for the scientific treatment of bituminous coal, producing coak, gas, ammonia, benzol and tar. The coke and gas would be utilized for cooking and heating purposes and the other by-products are in great demand in our various industries. Mr. Dick quoted from an authority to the effect that, "It is not beyond the bounds of reason to foresee a condition whereby a householder in the place of his ton of anthracite which he now welcomes for $11, will receive a ton of smokeless coal without slate, a month's supply of cooking gas, 40 miles of motor fuel, enough fertilizer to start a small garden and tar sufficient to allay the dust in front of his house—all for less money than he now pays for inferior coal."

The speaker went on to say that as a domestic fuel and for all industrial purposes, such as baking, drying, heating and steam raising, coke is fully equal to anthracite coal, weight for weight, and possesses many advantages. In European countries the use of coke for household furnaces is rapidly coming into favor. The paper also quoted figures to show that ground coke using impelled draft gave greater efficiencies as a boiler fuel in recent tests than coal slack, hard steam coal or smokeless Welsh coal. Further figures were quoted to show that coke has a higher relative fuel value than anthracite coal in house-heating boilers.

2. Railway Fuel Problem in Central Canada

There is little likelihood of Nova Scotia coal being used to any extent in Ontario, though under changed conditions Alberta coal may be brought farther east than it is at present. Mr. Dick believes that the railway fuel problem in Ontario can be made independent of foreign sources of supply only by means of electrification of railways or the use of powdered peat as a locomotive fuel. As the least expensive, electrification would seem to be the more reasonable solution.

3 and 4. Fuel Problem in Prairie Provinces

The amount of money which goes out of Canada to pay for imported coal for the prairie provinces is approximately $10,000,000 yearly, yet this is in the face of an almost unlimited supply of lignite and bituminous coal. It seems necessary that the inhabitants of this district should cease to look upon anthracite as a necessity and should develop the habit of using softer coals, such as are found within their own borders. The coal mines of Alberta and Saskatchewan have a capacity of producing 15,000,000 tons of coal per annum, whereas at the present time the production is scarcely over 5,000,000.

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*Mining engineer of the Commission of Conservation, Ottawa, Ont.

5. Railway Fuel Problem in Forest Areas of British Columbia and Alberta

Owing in part to the frequency of forest fires, but also to the very low cost of oil fuel in British Columbia, oil has been used largely in the coast province—something like 50,000,000 gallons being the yearly consumption previous to the war. At that time the price ranged about 45 cents a barrel, whereas it is now said to have reached a price of $1.75 in Seattle. It is also rumored that its export to Canada will be prohibited. It would thus appear that the railroads in British Columbia must revert to the use of coal as a fuel. In this connection Mr. Dick notes the progress in the art of adapting pulverized fuel to locomotive use and quotes a number of railways that have experimented satisfactorily with it.

In addition to all the other sources of economy, the paper urges guarding against waste in the operation of coal mines. The instinct of the miners naturally is to take out the coal which is of best quality and that can be removed at least cost, abandoning any area as soon as it becomes unprofitable. This is against the conservation of our coal areas and it is suggested that means should be taken to prevent these wasteful methods of mining.

Utilization of Peat as a Fuel

By John Blizard[*]

The investigations undertaken by the Mines Branch of the Department of Mines are of three kinds: (a) Those giving information as to quality, quantity of contents, and situation of the peat bogs; (a) those dealing with the manufacture of fuel; (c) those dealing with the use of peat.

The Mines Branch has investigated about 300 square miles of peat bogs, and finds that the average 25-per-cent. moisture peat fuel runs about 400,000 tons per square mile. The largest bog investigated contains 9,000,000 tons. The Ontario peat varies in calorific value from 7,400 to 9,100 B.t.u.'s per pound and the ash content from 4 to 26 per cent. Quebec peat has a somewhat higher calorific value of 8,500 to 9,500 B.t.u's per pound.

Difficulty in Removing Moisture

In the manufacture of peat the outstanding difficulty is the removal of water, which constitutes anywhere from 85 to 90 per cent. of the raw peat in a drained bog. Since it is necessary to reduce this water content to at least 25 per cent., it follows that 5¼ pounds of water have to be removed in order to obtain 1 pound of 25 per cent. peat fuel. This water has to be removed by evaporation, since pressure processes have not proved feasible. The only economical means of removing the moisture is by exposure to the wind and sun, and hence one of the difficulties in the Canadian climate where the season during which peat may be manufactured averages only about 100 days. The manufacture may be either by hand or by machinery, but, considering the cost of labor and the difficulty of procuring it, machine methods offer the greatest promise. Mr. Blizard described at some length the proper course to pursue in the manufacture of peat by machinery.

The use of peat as a fuel has been investigated by the Fuel Testing Division of the Mines Branch in both producer and boiler trials. Using a suction gas producer and gas engine of 60 h.p., a series of nine trials carried out at three-quarter load showed a consumption of 30,000 B.t.u.'s in the peat to produce 1 kw. h. at the switchboard, which compares favorably with the average steam power plant. The paper points out that where it is possible to find a market for large quantities of power, the by-product recovery producer plant will be the most economical. It includes a plant for the recovery of nitrogen in the form of ammonium sulphate, and, in consequence, is quite expensive. The nitrogen content of peat is high—around 2 per cent.—so that it should be possible to obtain about 120 pounds of ammonium sulphate per ton of peat, which, at the pre-war price of $65 per ton, is worth $3.90.

Losses Through Incomplete Combustion

To determine the steam-raising value of peat fuel with hand-firing, a series of six trials were carried out, using peat with a moisture content of 15 and 20 per cent. and a calorific value between 7,000 and 7,500 B.t.u. Results showed that the equivalent evaporation per pound of coal of about 12,500 B.t.u. was around 8, while with peat the evaporation was about 4 per cent. The thermal efficiency with the coal was of the order of 60 per cent. and, with the peat, 53 per cent. The low figure in the latter case is due to incomplete combustion of the gases and to their high temperature when leaving the boiler. In trials with a locomotive type of boiler a conspicuous feature was the great losses due to unburnt gases, which varied from 11 to 24 per cent.

The speaker referred, in closing, to the use of mechanical methods of firing peat that have been tried out on the European Continent; also the use of peat in the powder form as it has been used in locomotives in Sweden for some years, and where it has been shown that 1½ pounds of peat powder of 7,700 B.t.u. value will generate the same quantity of steam as a pound of coal of 12,600 B.t.u. value. Mr. Blizard believes that peat is destined to take the place of imported coal to a very great extent in the near future.

Low Temperature Carbonization of Fuels

By Edgar Stanfield[*]

This paper explained the nature and object of carbonization, outlining the history and development of the industry and pointing out the economic conditions which make its consideration imperative.

A fuel is carbonized in order to change its chemical and physical properties, thereby converting it into a new fuel or fuels of higher economic value. Certain by-products, although not fuels, are always produced simultaneuosly but not always recovered. Destructive distillation invariably yields solid, liquid and gaseous products, and is therefore carried out with one or more of three objects: (1) To obtain a solid fuel with certain desirable properties; (2) to obtain a gaseous fuel; (3) to obtain liquid products of value as fuel or as chemicals.

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Coke is seldom made as the principal by-product of carbonization, except when required for metallurgical purposes. High temperature carbonization is essential to produce a good quality of metallurgical coke and temperatures of 1,200 degs. to 1,300 degs. C. are maintained in the heating flues of some coke ovens. Gas was first manufactured in iron retorts and had to use as a limit the safe working temperature of iron which is about 800 degs. C., but with the use of fire brick ovens one could increase the amount of gas by increasing the temperature. However, as the gas yield increased the candle power and yield of tar was decreased and the gas manager was limited to a working temperature only by the necessity of providing the statutory candle power.

Our economic evolution has materially changed our outlook; a fuel such as bituminous coal is no longer merely a source of light, heat and power, but is a raw material of many industries and innumerable ramifications. Coal tar and ammonia are the sources of dyes, drugs, oils, disinfectants, explosives, fertilizers, etc.

The rapid progress in the use of gas for heat and power and the replacing of the old flat flame burner by gas mantles have led to almost complete abandonment of the old candle power standards and leave the gas industry free to make other advancements.

Low temperature tar is paraffinoid in character and high temperature tar is benzenoid, and it is the benzene compounds which are used in the manufacture of dyes. Low temperature tars further carry a large percentage of unstaple, unsaturated compounds. Hence the tar product of low temperature carbonization of coal would have to receive a different treatment to be of use to dye makers. In Great Britain a smokeless fuel is made by carbonizing soft coal at a temperature of 500 degs. C., and the resultant gas may be sold at a comparatively low rate.

Lignite

The carbonizing of lignite at low temperatures is a very important question for Canada, and since 1917 has been a matter of systematic investigation in the laboratories of the Fuel Testing stations at Ottawa. This coal, as mined, has a calorific value below 7,500 B.t.u. per pound and contains 30 per cent. water, which considerably lowers its efficiency. Several methods for increasing the commercial value of this coal may be suggested. For example, it could be powdered and briquetted. Unfortunately it lacks sufficient inherent binder so that a briquette will not stand handling and storage. Another method would be to carbonize the coal. Lignites, however, do not soften and coalesce when heated, but produce a friable material bearing about the same relation to coal as charcoal does to wood. Much work has been done in experimenting with lignites and one must conclude that the most hopeful remedy is the low temperature carbonization, possibly, with the recovery of by-products and the briquetting with the addition of a binder.

Carbonization

The carbonization experiments have been subdivided into small scale laboratory tests, large scale laboratory tests and semi-commercial tests. The small tests were largely used to cut down the number of large scale tests required and were checks on the accuracy of the larger tests. For the semi-commercial tests a rotary retort is being constructed with a capacity of about 50 pounds. This retort is designed for either intermittent or continuous use; in the latter case it will be possible to coke about 30 pounds of coal per hour. In these tests the results determined show the yield and calorific value of the residue; the yield composition and calorific value of the resultant gas; the yield, calorific value and the economic value of the tar oils produced, and the available ammonium sulphate yield.

The primary object of the investigation is not to design a commercial plant, but to obtain the accurate data essential for the scientific design and control of a plant. The investigations have shown: that the carbonized residue is subject to rapid disintegration; that the complete removal of the tar is difficult; that the nature of binder best applicable for use in the residue has not yet been determined.

With peat, as with lignite, carbonization converts a low grade fuel into one with high calorific value and low volatile content. Peat, however, unlike lignite, does not disintegrate when heated, and the carbonized residue, generally called peat coke, is distinctly stronger and harder than wood charcoal and may be used without briquetting. The increased price of wood has resulted in experiments to ascertain whether peat could be used as a source of wood alcohol, acetate of lime, etc.; the yields were low but the substitution is not impossible.

It must be clearly understood, however, that carbonization could only be supplementary to, not a substitute for, air drying, as the cost of distilling wet peat would be prohibitive.

Oil shale is not, as its name suggests, shale impregnated with oil. It contains little or no free oil, but does contain bituminous matter that yields oil when subjected to destructive distillation. Low temperatures are employed to avoid the wasteful breaking down of the oil vapour into permanent gases.

Wood was formerly carbonized for the sake of the charcoal; at present wood alcohol, turpentine, acetic acid, and wood tar oils are products more in demand than the charcoal. It is customary when distilling wood to drive off the water as rapidly as possible, and then to maintain a temperature in the retort of slightly below 300 degs. C., as long as distillation continues. The process is then completed by raising the charge to about 500 degs. C.

In conclusion, therefore, it may be stated that although the low temperature carbonization of bituminous coal appears likely to assume importance in England, and possibly elsewhere, no such development is in sight in Canada. The low temperature carbonization of lignite, peat, oil shale, and wood, however, may play a considerable part in the economic development of this country.

Erection of the Quebec Bridge

By Geo. F. Porter*

THE project of building a bridge over the St. Lawrence River at Quebec first assumed definite form in 1898, when tenders were called for on specifications issued by the Quebec Bridge & Railway Company, which finally resulted in awarding the contract to M. P. Davis & Sons for the substructure, and to the Phoenix Bridge Company for the superstructure. On August 19, 1907, the entire superstructure which had been erected on the south side collapsed, involving the complete abandonment of the enterprise.

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* Engineer of Construction, St. Lawrence Bridge Company, Montreal, Que.

In August, 1908, the Dominion Government appointed a board of engineers to prepare plans and specifications of a new bridge. This board was composed of Mr. H. E. Vautelet, Mem. Can. Soc. C. E., chairman; Mr. Fitzmaurice, C.M.C., of London, England; and Mr. Ralph Modjeski, Mem. Am. Soc. C. E. This board, toward the end of 1909, developed what was known as the "official design" and tenders were called for its construction, the tenderers being given the privilege of submitting their own designs if they so desired.

Four tenders were received, and eventually the design and tender of the St. Lawrence Bridge Company, an amalgamation of the Dominion Bridge Company and the Canadian Bridge Company, were accepted.

A prominent clause of the contract was as follows: "The contractor will be required to guarantee the satisfactory erection and completion of the bridge, and it is to be expressly understood that he undertakes the entire responsibility not only for the materials and construction of the bridge, but also for the design, calculations, plans and specifications, and for the sufficiency of the bridge for the loads therein specified, and the enforcement of any part or all parts of the specifications shall not in any way relieve the contractor from such responsibility."

The bridge company immediately began to organize to carry out the work, and built a shop to fabricate the structure amounting to 66,000 tons of steel for the bridge and 10,000 tons for shop and erection purposes. This plant represented an outlay of $1,300,000 and included cranes of 190 tons capacity and many machines of unusual type. At the same time that the drawings for the bridge were being made the method of erection was being developed in detail, as it was necessary to know how every member was to be handled in the field before the drawings could be completed. Drawings were also made for shipping many of the larger members, and special cars built to carry them. Four different methods of erecting the suspended span were considered: First, it could be cantilevered out to the centre; second, build a light structure to be floated in and raised to position and used as a staging to erect the span on; third, to float it in a high enough position to connect it to the cantilevers, letting the supporting barges float out as the tide subsided, and lastly, the method used of erecting it on a low staging, floating it on barges to the site and raising it to its final position with specially designed tackle.

The traveller used in erection was of original type. It has four tackles of 60 tons capacity mounted on electric cranes which travelled on top and were high enough to place the highest and heaviest members. It had four 15-ton tackles on four booms on each corner, eight 5-ton tackles mounted on gantrys which were placed on the top of the electric cranes and an elevator of 3 tons capacity for going to the top. The whole was electrically operated, controlled from a deck immediately over the railway tracks, enabling the operator to see what was being done at all times.

Staging for Anchor Arms

The staging of the anchor arm was entirely of steel and built on separate foundations. During the season of 1915, the two anchor arms were completed and preparations were made for the erection of the suspended span which was fabricated at Sillery, and in the meantime six steel scows, manufactured at Sorel, arrived on the site, and everything was ready with the lifting apparatus in place on the cantilevers, scows in place under the span, for the operation of lifting the huge span into place on September 11, 1916. The place selected for the erection of the centre span was a comparatively level place near Sillery. The site was so situated that there was no water under the span at low tide and 15 feet under it at high tide. The scows had valves fitted to the bottom and when the tide rose the span was lifted from its supports and towed into the stream and to the bridge site. Six lifts had been taken and the critical stage of the operation considered past when there was a loud report at the southeast corner which suddenly dropped from its support and the whole span was precipitated into the river.

On the same day the St. Lawrence Bridge Company announced that they would take immediate steps to replace the span and that they proposed using the same method over again, and in spite of the difficulties encountered were ready to begin erection on the anniversary of the day it was begun in 1916. On September 20, 1917, the last lift was made and the last coupling made, and on October 17 the first locomotive and cars passed over the bridge. Mr. Porter's lecture was splendidly illustrated by lantern slides, showing various phases of construction, erection and erection appliances.

Ontario's Efforts to Relieve the Fuel Situation

By Albert Grigg*

The Ontario Government is busy working out a solution of the problem of fuel shortage. They are of the opinion that, while this is a very great problem, it is not altogether the shortage of fuel, but also there is involved the question of teaching the people of the country to economize and conserve. The people are slow to realize that there is a real shortage and that the war has only aggravated a condition that we would have had to cope with in any case. Our present condition is only one other example of our unpreparedness, though this very unpreparedness for the war is our great vindication. The government is taking very active measures to impress upon the people the actual fuel situation, and are instituting an educational propaganda by circularizing the whole province and advertising in all the local papers.

In Ontario, owing to our geographical position, our denser population, and the fact that we have no coal deposits, the situation is more acute than in the other provinces. The Eastern and Western provinces could, with some additional development, look after themselves. The increased tax on the United States resources means that we cannot look forward for the abundant supply of coal we have had shipped to us in the past.

There are two known sources of fuel in Ontario—peat and wood, with wood available during the coming winter. Each province has a fuel controller, and in the large centres deputy fuel controllers have been appointed. The government has granted to municipalities the wood on crown lands, and they are to cut this during the coming summer. Toronto, Hamilton, Ottawa, and Sudbury have already taken advantage of this offer.

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* Deputy Minister, Department of Lands and Forests, Ontario, Toronto, Ontario.

The department itself has taken action, and expects to cut and deliver enough wood this summer to supply fuel for all government institutions. This means in some cases a readjustment of some of the heating plant in order that wood may be used profitably and economically. An appropriation of $100,000 has been set aside for the investigation and working out of the problems as they arise.

The lesson of the war is self-reliance; had we been thrown entirely on our own resources we would have been in a very bad condition.

Gas for Light, Heat and Power

By Arthur Hewitt*

In his introduction, Mr. Hewitt paid tribute to the United States officials at Washington, saying that at no time during the period of stress last winter did any person get anything but the very best of treatment from these parties, and that the West had no reason for complaint, since they received the preference over all.

The fuels available for use in Canada are coal, wood, petroleum, gas and water-power electrically distributed. Manufactured gas or "city" gas must be given an important place. This gas possesses the following physical properties: It is a permanent gas; it is susceptible to subdivision, and it is a cleanly and readily available fuel.

One ton of gas coal in an efficient carbonizing plant will yield 10,000 cubic feet of gas, from which may be extracted a certain percentage of benzine and toluol. It will produce 1,350 pounds of coke, from which, after providing fuel for the producers, there is a residue of 800 to 850 pounds, which may be marketed. It will yield 10 imperial gallons of coal tar, from which may be recovered toluol, benzine, fuel oil, acids, dyes, etc. There are other by-products, such as ammonia, used for fertilizers, and retort carbon, used for electrodes. It is estimated that the percentage of efficiency obtained from a ton of coal treated in a gas works will run from 60 to 70 per cent., against an efficiency of probably 20 per cent. obtained in ordinary practice.

Gas may be used for a variety of purposes, such as for lighting, cooking, industrial purposes, such as heating liquids, ovens, melting metals, making steam, and numerous other uses.

Each class of fuel available for consumption in Canada should be selected and appropriated for the purposes for which it is inherently and economically best suited, regard being had to the essential objectives of:

1. Limiting the necessity for importing fuel from other countries.

2. Limiting as far as possible the use of high-grade gas coal to the purposes for which the largest percentage of its efficiency can be usefully employed.

3. Avoiding the use of fuel requiring a long haul wherever it is possible to secure a suitable substitute requiring only a short haul.

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*Gen. Man. Consumers Gas Co. Toronto.

Wood as an Emergency Fuel

By E. J. Zavitz*

The wood lands of Southern Ontario would not replace coal to any appreciable degree, and in a large number of cases many counties in Ontario have less wood than counties in the Old Country, and the thickly populated sections of the United States. Many counties in Ontario have only five per cent. of their area covered with inferior wood, while many of the eastern states have fifteen and twenty per cent. well wooded.

Educational propaganda such as the government now proposes should have been instituted years ago, and the extravagant waste of wood in rural communities stopped. Some districts such as Brant and Oxford, are just as dependent on coal as are the large cities. The large belt of hardwoods in Ontario lies between North Bay and Ottawa. Further north the woods are principally resinous. If the cities require hardwoods it is from this district that it would have to be brought. The simplest method for a community to secure wood would be to let contracts to local contractors for wood delivered to the sidings and ready for shipment.

The calorific value of wood varies directly as its weight; thus a cord of white oak weighs approximately 4,000 pounds, and is equivalent to one ton of anthracite coal, and a cord of spruce or pine weighs in the neighborhood of 2,000 pounds, and is equivalent to one-half ton of coal. The principal hardwoods available for fuel are maple and birch, which weigh between 3,000 and 3,500 pounds to the cord. Dry wood is very much better and more efficient than green wood, which contains at least 25 per cent. moisture. This water requires heat to be evaporated, which passes up the flues.

The wood that has not yet been cut will lack fuel value. Winnipeg has laid in 50,000 cords of tamarac which will replace 35,000 tons of coal. The principle to impress upon the consumers is not altogether that so many cords of wood will replace so many tons of coal, but to teach them how to make use of wood to economize coal.

[The remaining papers on the program are either reproduced in the following pages of this issue or will appear later.—Editor].

Under an arrangement with the Hon. C. C. Ballantyne, Minister of Marine, the Dominion Iron & Steel Corporation will construct a plant at Sydney, Cape Breton, for the rolling of steel plates for shipbuilding purposes. The plant will be ready in about 15 months. The company will receive Government orders, and will also be open to execute ordinary commercial orders. The arrangement is part of the Government's programme to meet the world-wide shortage in vessels and to assist the Canadian shipbuilding industry. The contract with the Government calls for 250,000 tons of ships' plates, over a period of five years, with a minimum of 50,000 tons a year. The cost of the mill is estimated at five million dollars.

The Rock Ornamental Company has been incorporated, with a capital of $20,000, to engage in all business allied to the cement industry. The head office is in Quebec City.

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*Provincial Forester, Ontario.

Canada's Water Powers and Their Relation to the Fuel Situation

By J. B. Challies*

The subject assigned to me in connection with this fuel-power symposium meeting of the Canadian Society of Civil Engineers is the relation of water-power to the fuel situation in Canada. At first "blush" it might appear that water-power has only an indirect and limited connection with the recent critical fuel shortage which, through suspended effort, has caused temporary industrial stagnation and local domestic hardships of enormous extent and involving great financial loss Even a casual general survey of our fuel-power requirements, however, will indicate that not only has water-power a very direct and important bearing on the present situation. but that water-power must, in the future, take a very much greater share in our fuel-power burdens.

Heat, Light, and Power Needs—One Problem

It is axiomatic that our heat, light, and power needs must be considered as one great national problem, and also that Canada's domestic and industrial development depends primarily on the co-ordinated use of all the fuel-power resources of the Dominion.

Development along independent and divergent lines has, in the past, prevented adequate correlation of the great Canadian industries of fuel production and hydro-power supply. There is now, however, as a result of the fuel shortage, developed a concensus of opinion among men familiar with fuel and hydro-power matters in Canada that there is between these allied industries enormous scope for national co-operation which would be conducive to their mutual advantage, as well as to the common weal. I propose to show:

First—That water-power must take a very prominent part if the best use of the varied fuel-power resources of Canada is to be achieved; and

Second—That there must be evolved a national master fuel-power policy which will realize the best possible co-ordinated and concomitant development and use of all the fuel-power resources of the Dominion.

Interdependence of Water-Power, Coal, Wood, Peat, Oil and Gas

Within the last two days we have had recognized experts describe the possibilities and proper functions of our different available fuels—coal, wood, peat, oil, and gas. Practically every speaker has indicated their interdependence and their interchangeability of use. It remains for me to demonstrate the relation of "white" coal to all other fuel-power agencies, and to point out that they must all "coalesce" in meeting the fuel-power requirements of the country.

To furnish a quick general summary "bird's-eye view" of the "white" and black coal situation in Canada, and to indicate their integrity I have had several maps and diagrammatic statements specially prepared for submission at this meeting.

Pacific and Atlantic Provinces Self-Sustaining, but Central Provinces Dependent for Coal

Plate No. 1 represents the coal consumption and production in Canada. The tabulated statement on the top of the

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* Superintendent Dominion Water Power Branch, Department of the Interior, Ottawa, Ont.

SOURCES OF DATA

This data obtained from

Alberta. Dept of Public Works, Annual Report, 1916.

Albert Dept of Mines. Quarterly Bulletin, 1917.

British Columbia. Bureau of Mines, Annual Report, 1916.

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U.S. Geological Survey, The Coal Fields of the United States, 1917. (Professional Paper 100-A,

U.S. Geological Survey, Coal in 1915 Part A, Production; (Part B, Distribution and Consumption,) 1916.

CONSUMPTION	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID	NEW BRUNSWICK	NOVA SCOTIA	GRAND TOTALS
Domestic										
Anthracite	10,544②	113 130②	28,197②	1,658②	—	—	—	—	—	
Bituminous	1311 433②	1951 833②	140 413②	17,719②	—	994,944①	82,924①	891,031①	2,826,300①	
Lignites	21,143②	959,526②	1,134,346②	79,252②	—	—	—	—	—	
Total Domestic	1,343120	3,024,489	1,302,956	98,629	—	994,944	82924	891,031	2,826,300	10,701,530
Imported										
Anthracite	—	Small	208,000③	325,000③	2,242,874③	1,794,410③	—	Small	Small	
Bituminous	—	Small	718,879③	1,627,998③	6,459,105③	4,174,850③	—	—	—	
Total Imported	—	Small	926,879	1,952,998	8,701 979	5,969 260	—	Small	Small	17,580,603
Total Consumption	1,343,120	3,024,489	2,229,835	2,051,627	8,701,979	6,964,204	82,924	891,031	2,826,300	28,282,133
Total Production	2,584,061	4,559,054	281,300	—	—	—	—	143,540	6,912,140	14,480,095
Production over consumption	1,240,941	1,534,565	—	—	—	—	—	—	4,085,840	
Consumption over production	—	—	1,948,535	—	—	—	—	747,491	—	
Consumption no production	—	—	—	2,051,627	8,701,979	6,964,204	82,924	—	—	
	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	ONTARIO	QUEBEC	PRINCE EDWARD ID	NEW BRUNSWICK	NOVA SCOTIA	

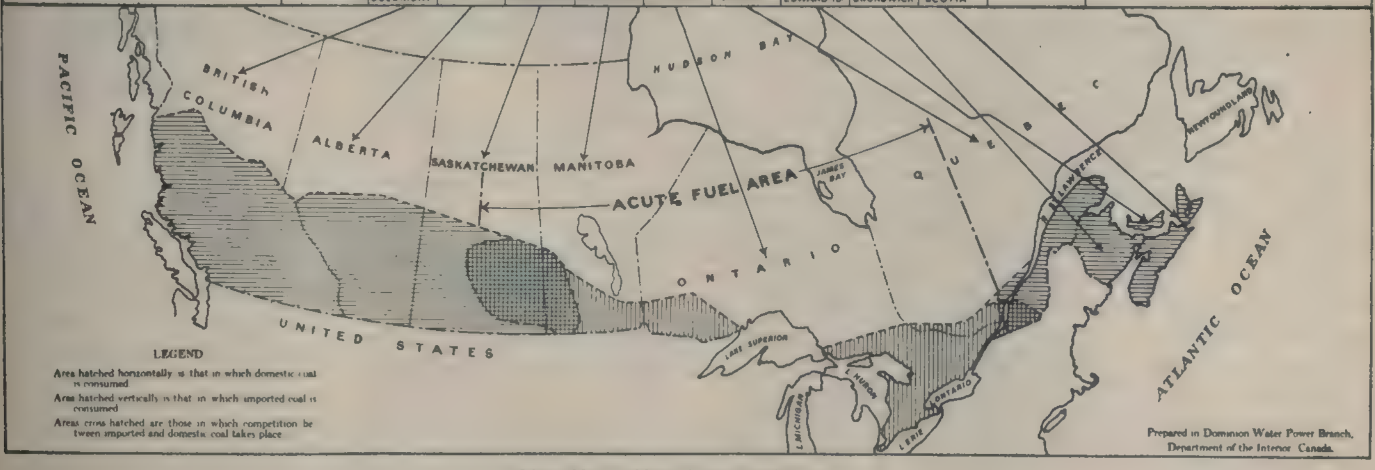
REMARKS

This compilation is based on 1916 figures. Consumption areas become somewhat distorted because 8 000 000 tons, or about ¼ of the consumption is railway coal, and as such is carried from province to province as traffic necessitates.

Tonnages (1) Are from Mines and other reports of provinces concerned.
(2) Are from combinations of reports of provinces concerned.
(3) Are calculated, allocating the tonnage according to population and known consumption, both imported and domestic, deductions and additions being made accordingly for domestic and imported tonnages in order to arrive at a reasonable figure. These figures cannot be obtained direct from any Government report.

Differences in totals are accounted for partly by taking arbitrary figures in some cases for purposes of calculation and by different methods of tabulation and statistics.

NOTE Basic data compiled and tabulated by Mr J F E Brown Mining Engineer


PACIFIC OCEAN
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
HUDSON BAY
ACUTE FUEL AREA
JAMES BAY
QUEBEC
ONTARIO
NEWFOUNDLAND
ST. LAWRENCE
ATLANTIC OCEAN
UNITED STATES
LAKE SUPERIOR
L. MICHIGAN
L. HURON
ONTARIO
L. ERIE
LEGEND
Area hatched horizontally is that in which domestic coal is consumed.
Area hatched vertically is that in which imported coal is consumed
Areas cross hatched are those in which competition between imported and domestic coal takes place

Prepared in Dominion Water Power Branch, Department of the Interior Canada.

Plate No. 1—Note Acute Fuel Area.

plate summarizes the consumption in the various provinces of the different classes of coals, both domestic and imported. You will observe the greatest consumption is in Central Canada, including the Provinces of Manitoba, Ontario, and Quebec. Coal production is greatest in the extreme western and eastern provinces. British Columbia and Alberta, on the one hand, and Nova Scotia, on the other, not only meet their own coal requirements, but produce a very considerable overplus for consumption in the contiguous portions of Central Canada. The central provinces—Manitoba, Ontario, and Quebec—are almost wholly dependent on outside sources, mainly imported coals. This is clearly shown by the hatched areas on the map, the horizontal hatching covering the areas which produce their own needs, the vertical hatching covering the areas which are dependent. Where there is cross-hatching, both Canadian and imported coals are consumed. It is to be observed that Central Canada, where consumption is greatest, is non-productive. This I have termed the "acute fuel area" of Canada.

An Acute Fuel Area in Canada Largely Dependent on Imported Coal

This "acute fuel area" is now dependent for domestic requirements mainly upon Pennsylvania anthracite and for industrial needs upon Pennsylvania bituminous coals, as well as upon Canadian water-power. So far as domestic heating requirements are concerned, Mr. Dick, the consulting mining engineer of the Conservation Commission, in his paper on the "Rational Development of Canadian Coal Resources," has pointed out the possibilities of the western portion of the "acute fuel area" being furnished with briquetted lignite from the prairie provinces. Mr. Stansfield, of the Dominion Mines Branch, in his paper on "The Low Temperature Carbonization and Briquetting of Bituminous Coal," has pointed out the possibilities of meeting the domestic heating requirements of the eastern portion of the "acute fuel area" by the product from the low temperature carbonization of Nova Scotia bituminous coals. Although both these processes are proven to be practicable, they are as yet in their formative or agitational stage, and some considerable time must elapse before they can be placed on a commercial basis to furnish sufficient fuel to substitute for any large portion of the Pennsylvania anthracite now imported for domestic heating. There is at the present time no available supply, even in small quantities, of a Canadian coal fuel to take the place of imported anthracite. Nevertheless, this "acute fuel area" can eventually be made independent of foreign fuel imports, and Canada can become self-sustaining, at any rate, in respect of her domestic heating requirements. There must, as a necessary preliminary, be a national, co-ordinated development and use of all the available fuel and power-producing agencies in the Dominion. Such a co-ordination must be a matter of gradual evolution and adoption, and will, to a great extent hinge on whether Canada can reasonably expect assured fuel imports from the United States for a considerable period in the future.

Canada an Exporter of Electrical Energy

As we are now exporting large quantities of coals from British Columbia and Nova Scotia into adjacent states of the Union, and as we are also exporting about 275,000 horsepower of electric energy, equal in value to about 3,000,000 tons of coal, it is obvious the United States cannot afford to place a sudden and complete embargo on coal exportation to Canada. The two countries must deal with each other, at least, upon a basis of quid pro quo. Providing Canada has her own fuel resources under strict national control, this power exportation should assure her an importation of sufficient coal to tide over any readjustment period necessary to permit of an ultimate dependence on Canadian sources of fuel and power.

Exportation of Electrical Energy and Assurance for Fuel Needs

The exportation in the past of Canadian electric energy has not been without compensating advantages. An assured United States market for Canadian power loads has enabled the financing and completion of several hydro-electric projects, the construction of which, so far as domestic markets alone are concerned, would not have been warranted at the time. The initial United States power load has, therefore, made it possible for the domestic market to reap all the benefits of available hydro-electric energy many years sooner than otherwise would have been possible.

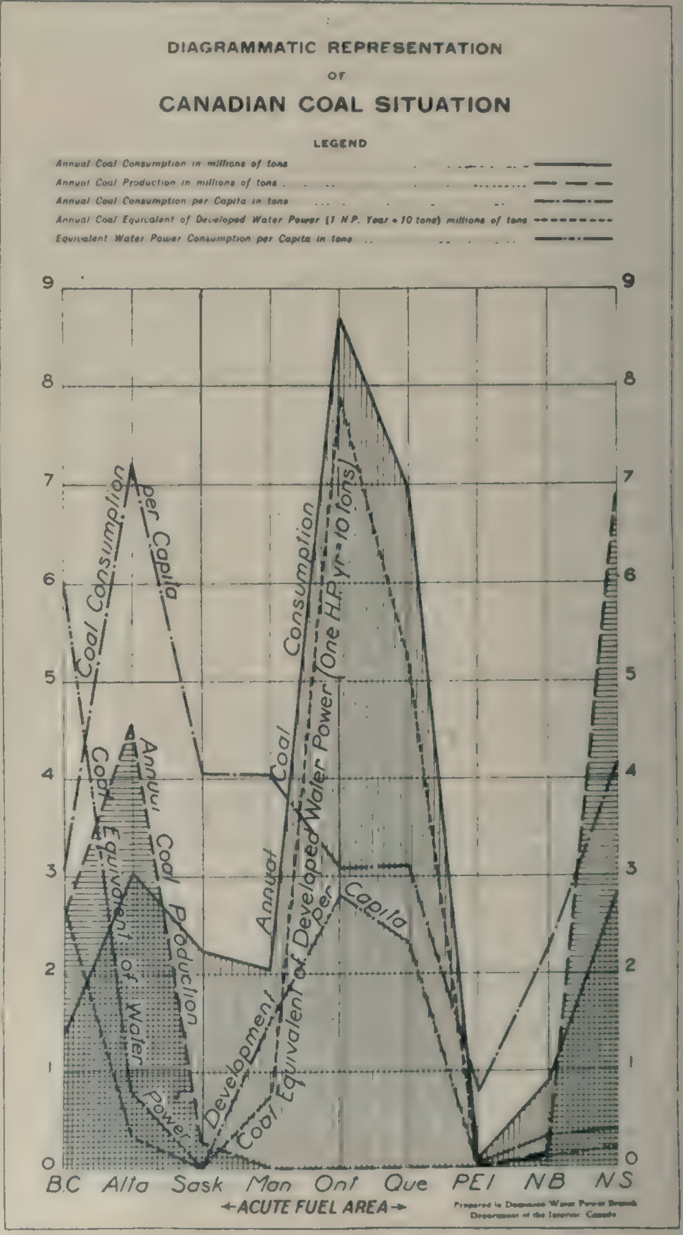


Plate No. 2—Canadian coal situation.

While Canada has been receiving far more value in her coal importation than she has given in her power exportation, the advantage is rapidly disappearing. It is reasonble to expect that the tendency will be for hydro-power exportation to increase and for coal importation to decrease. The time may come, and in the near future, when the balance will be against Canada.

It is, therefore, imperative that every proposal for increase in the exportation of power be carefully considered from a broad, national standpoint. Such consideration involves the evolution of a formula with regard to power exportations which will have cognizance of Canada's fuel-power needs generally.

We must face the fact that for some time to come we shall require to import United States coal, and that in turn therefor we can, under proper conditions of recovery, safely and profitably export some of our surplus hydro-electric energy.

Canada, to Become Self-Sustaining, Must Use All Her Fuel-Power Resources According to Their Particular Adaptabiliity

Mr. B. F. Haanel, chief of the Fuel Testing Division, Department of Mines, in his clear and comprehensive paper on the "Fuels of Canada," describes the nature, location, and extent of our varied available fuel resources. Mr. Haanel affirms that, while the problems associated with the distribution of fuel to the various parts of Canada are exceedingly complex and the strictest conservation must be practised, the Dominion is endowed with fuel deposits on such a magnificent scale that all that is necessary is their proper exploitation and economic use for the country to be eventually practically independent of foreign sources of fuel. Mr. Haanel is particularly emphatic that Canada need not go abroad for fuel for household use, if her own fuel resources are properly exploited.

Country	Area Sq. miles.	Population latest available figures.	H.P.Available	H.P.Developed	Per cent utilized	H.P.Available per sq.mi.	H.P.Developed per sq.mi.	H.P.Per Capita	
								Available	Developed
U.S.A.	2,973,890	98,783,300	28,100,000	7,000,000	24.9	9.4	2.35	0.28	0.071
Canada 'A'	2,000,000	8,033,500	18,803,000	1,735,000	9.2	9.4	0.87	2.34	0.216
Canada 'B' Populated	927,800	8,000,000	8,094,000	1,725,000	21.3	8.7	1.86	1.01	0.216
Austria-Hungary	261,260	51,173,000	6,400,000	566,000	8.8	24.8	2.17	0.13	0.011
France	207,500	39,601,500	5,587,000	1,100,000	11.6	26.8	3.14	0.14	0.016
Norway	124,130	2,391,780	5,500,000	1,120,000	20.4	44.3	9.02	2.30	0.468
Spain	190,401	19,588,700	5,000,000	440,000	8.8	26.3	2.31	0.26	0.022
Sweden	172,960	5,522,400	4,500,000	704,500	15.6	26.0	4.08	0.81	0.127
Italy	91,400	28,601,000	4,000,000	976,300	24.4	43.8	10.7	0.14	0.034
Switzerland	15,976	3,781,500	2,000,000	511,000	25.5	125.2	32.0	0.53	0.135
Germany	208,800	64,926,000	1,425,000	618,100	43.4	6.8	2.96	0.02	0.010
Great Britain	88,729	40,831,400	963,000	80,000	8.3	10.9	0.91	0.02	0.002

"A" excludes Yukon and Northern Area improbable of immediate development. "B" included in "A" is area actually settled.

Plate No. 3—Water powers in Europe and North America—Dominion Water Power Branch estimate, slightly revised.

The problem of Canada's fuel needs outside of the "acute fuel area" offers little difficulty, owing to an abundance of both coal and water-power. It is simply a matter of efficient and effective use of available resources. Within the "acute fuel area," however, the problem is pressing and prodigious. It resolves itself into two parts—first, provision for domestic or household heating consumption; second, provision for industrial requirements.

Domestic Requirements

1. Domestic requirements of "acute fuel area" involves production of suitable substitute for anthracite.

Domestic needs involves the production of a fuel or fuels which will meet the requirements for general household use. At the present time this need is furnished by American anthracite; over 4,000,000 tons were used in 1916. Competent experts declare the anthracite coal fields of the United States are in measurable distance of exhaustion, and that the supply will not last a hundred years. Having in mind the ever-increasing demands within their own borders for this fuel, and the rapid decrease in quality as the supply becomes exhausted, responsible fuel advisers of the United States Government have seriously urged the establishment of an embargo against exportation of anthracite. We in Canada must realize that our supply of this fuel may be gradually restricted. It is, therefore, essential that we, without delay, consider what can be accomplished in the production of a suitable substitute for United States anthracite.

Industrial Requirements

2. Industrial requirements of "acute fuel area" involves (a) more efficient use of soft coal in central heating stations; (b) construction of super-power plants to serve contiguous industrial areas; (c) substitution of hydro-power for steam-produced power wherever possible; (d) use of hydro-power for all new industries wherever practicable.

The second part of the "acute fuel area" problem and the one with which water-power is most intimately connected is the fuel necessity of the industrial or manufacturing world.

The industrial requirements are now met by Canadian hydro power and United States bituminous coal—about 14,000,000 tons consumed in 1916 for this purpose in the "acute fuel area."

Owing to the large reserves of bituminous coal in Pennsylvania, this class of fuel will probably be available to the "acute fuel area" of Canada for many years. Although not immediately necessary, the ultimate substitution of bituminous coals must nevertheless be seriously considered. Water-power will be the main means of such substitution. The industrial fuel problem, therefore, in the "acute fuel area" becomes largely a matter of substitution of hydro power for fuel power.

Electrification of railways—especially terminals with adjacent engine divisions—would save enormous consumption of bituminous coal and relieve our transportation systems of their greatest burden.

It is estimated that something like 9,000,000 tons of coal was consumed by our railroads in the year 1917. Judging from the results obtained from the electrical operation of railroads in the United States, it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives. This would be a saving of 6,000,000 tons of coal in one year, and would require about 900,000 water horse-power.

Electrification of steam roads at this juncture is not advocated. Under normal conditions, however, and in certain districts, as in Western Ontario, electrification will become an economic necessity in a few years.

In districts that cannot be served by water-power, the location of modern, efficient, super-power stations at strategic points, with a resultant elimination, or combination, of many inefficient small stations, would cause a very large saving in the consumption of soft coal, with a concurrent increased production of power.

The substitution in industry generally of hydro power for steam fuel power would also result in a tremendous relief. There are many plants where such an exchange would be possible now. Future manufacturing plants should be encouraged to locate where hydro power is available.

Water-power must be depended upon very largely to serve the industrial fuel-power situation in the "acute fuel area" of Canada.

The relation between developed water-power and the coal production and consumption in the various provinces is represented on Plate 2. It is interesting to note that in the "acute fuel area" there is about as much water-power developed, so far as coal value is concerned, as there is coal consumed. It is portentious that the bulk of our water-power production at the present time is within the "acute fuel area," and it is reassuring to know that our largest and most important potential water-powers are located within transmission range of present congested industrial districts within the "acute fuel area."

Canada Is Exceedingly Fortunate in the Extent and Location of Her Water-Powers

When considered in retrospect the production of hydro power in Canada has undoubtedly been an industrial achievement and an engineering triumph worthy our nation. In the short space of about twenty-five years there has been developed and put in use nearly 1,800,000 water horse-power. A tabulated statement (see Plate No. 3) of the water-power development in other countries, compiled recently from all available data, shows the universal importance of this resource, and indicates the splendid comparative position Canada enjoys in both potential and developed water-power. The present per capita power development in Canada is larger than all other countries except Norway. It is the same with respect to our known undeveloped water-power. No country enjoys to a greater degree the benefits of cheap dependable hydro power, and no country has had these benefits more universally applied for municipal, industrial, and domestic use. That Canada is recognized as one of the great water-power countries in the world is due largely to:

1. The nature and extent of our water resourses—abundance and seasonable distribution of rainfall; the regimen of our rivers—upper waters well forested with large lakes, suitable for regulation, rivers flowing through valleys with well-concentrated falls.

2. The fortunate location of the waterfalls with respect to existing commercial centres and related raw materials.

3. The consistent endeavors of governments, Dominion and provincial, in having water-powers thoroughly investigated and intelligently administered.

4. The business acumen and foresight of the capitalist and the professional skill and courage of the engineer in blazing the trail of pioneer water-power development and use.

5. The almost universal adaptation of electric energy for municipal, industrial, and domestic purposes.

Fortunate Location of Water-Powers

The outstanding feature of the water-powers of Canada is their fortunate location with respect to existing commercial centres. Within economic transmission range of practically every important city from the Atlantic to the Pacific, except those in the Central Western prairies, there are clustered water-power sites, which will meet the probable demands for hydro power for generations. The following table, prepared by the Dominion Water-Power Branch, indicates, reasonably accurately, the provincial distribution of the developed and undeveloped water-powers within the settled portions of the Dominion:

Province.	Power available.	Power developed.
Ontario	5,800,000	789,466
Quebec	6,000,000	520,000
Nova Scotia	100,000	21,412
New Brunswick	300,000	13,390
Prince Edward Island	3,000	500
Manitoba		76,250
Saskatchewan	3,500,000	100
Alberta		32,860
British Columbia	3,000,000	269,620
Yukon	100,000	12,000
Totals	18,803,000	1,735,598

Small Portion, Not 10 Per Cent, of Canada's Available Water-Powers Developed

In general, the use of water-power in Canada may be briefly described as follows:

(a) For municipal, including domestic and ordinary in-

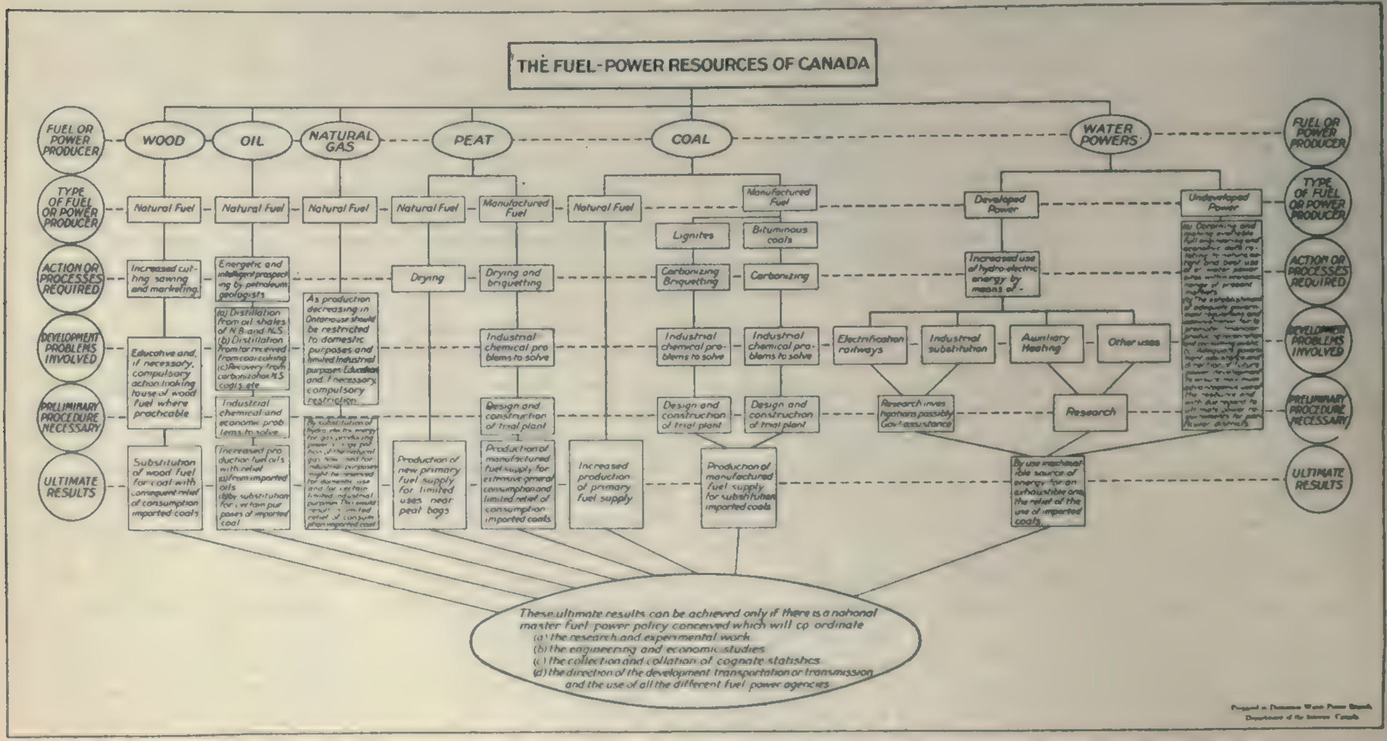

THE FUEL-POWER RESOURCES OF CANADA
FUEL OR POWER PRODUCER
TYPE OF FUEL OR POWER PRODUCER
ACTION OR PROCESSES REQUIRED
DEVELOPMENT PROBLEMS INVOLVED
PRELIMINARY PROCEDURE NECESSARY
ULTIMATE RESULTS
WOOD
OIL
NATURAL GAS
PEAT
COAL
WATER POWERS
Natural Fuel
Manufactured Fuel
Lignites
Bituminous coals
Increased cutting sawing and marketing
Energetic and intelligent prospecting by petroleum geologists
Drying
Drying and briquetting
Carbonizing Briquetting
Carbonizing
Developed Power
Undeveloped Power
Increased use of hydro-electric energy by means of -
(a) Distillation from oil shales of N.B. and N.S. (b) Distillation from tar received from coal coking (c) Recovery from carbonization N.S. coals etc
As production decreasing in Ontario use should be restricted to domestic purposes and limited industrial purposes Education and if necessary compulsory restriction
Educative and, if necessary, compulsory action looking to use of wood fuel where practicable
Industrial chemical and economic problems to solve
Industrial chemical problems to solve
Electrification railways
Industrial substitution
Auxiliary Heating
Other uses
Design and construction of trial plant
Research involving hydraulics possibly Gov't assistance
Research
Substitution of wood fuel for coal with consequent relief of consumption imported coals
Increased production fuel oils with relief (a) from imported oils (b) by substitution for certain purposes of imported coal
Production of new primary fuel supply for limited uses near peat bogs
Production of manufactured fuel supply for extensive general consumption and limited relief of consumption imported coals
Increased production of primary fuel supply
Production of manufactured fuel supply for substitution imported coals
By use inexhaustible source of energy for an exhaustible one the relief of the use of imported coals
These ultimate results can be achieved only if there is a national master fuel power policy conceived which will co ordinate
(a) the research and experimental work
(b) the engineering and economic studies
(c) the collection and collation of cognate statistics
(d) the direction of the development transportation or transmission and the use of all the different fuel power agencies

Plate No. 4—The fuel resources of Canada.

dustrial purposes, about 78 per cent. of total developed, or 1,348,490 h.p. So far as these uses are concerned, further requirements will probably be met for some years by additional installations at and increased storage for existing plants. In certain centres, however, as, for instance, the Niagara power zone, growing requirements can only be met by new water-power developments.

(b) Pulp and paper, about 14 per cent. of total developed, or 248,075 h.p. Further pulp and paper plant requirements can probably be met for some time by additional installations to present plants, although the tremendous growth of this industry will necessitate the development of new water-powers in different parts of the Dominion. There are now 54 pulp and paper plants scattered throughout Canada, and several new plants have been under serious contemplation, some of which would be in use now had it not been for the difficulty of financing, due to war conditions. On account of the isolated nature of the industry—away from commercial centres—power requirements for pulp and paper need not conflict with other demands upon hydro power.

(c) Electro-chemical and similar processes, about 8 per cent. of total developed, or 140,000 h.p. While the United States have achieved almost a world-supremacy in electro-chemistry, this industry in Canada is of very recent growth. It has, however, expanded at an enormous rate, entailing recent extensive additional installation in present plants, and requiring in the near future the development of additional water-power sites. Our propinquity to the United States and our abundance of essential raw material will compel the migration to the Dominion of many new electro-chemical plants of importance and value.

The products of the electro-chemical industry are extremely diversified. They include aluminum, silicon, calcium-carbide, cyanimid, ferro-alloys, graphite, carborundum, chlorine, etc., many of which are indispensable in the arts and in manufacture. Without aluminum the modern high-speed scout airplane would not exist; without electro-chemical abrasives and ferro-alloys manufacturing processes would be lengthened many fold.

One of the most important electro-chemical processes is the fixation of nitrogen. About 30,000 h.p. is used for this purpose at Niagara by the American Cyanamid Company, and, while other plants of this kind have so far not been put into operation commercially in this country, they have been seriously contemplated, and await only a sufficient source of low-price power for realization.

The electro-metallurgical industry is in its infancy, but promises great expansion, especially in the production of nicu-steel in Canada. Few people appreciate the rapid growth during the last few years in the use of electric furnaces for the production of the highest grades of steel.

By proper foresight the demand for hydro power for these industries need not conflict with other demands, as, for instance, municipal, domestic. and ordinary industrial uses.

Total developed power about 1,735,598 h.p.

Further Use of Hydro-Electric Power

In considering the future of water-power development in Canada it is important to note that it means the use of a non-expendiple resource, and in many cases represents the substitution of an inexhaustible resource f. an exhaustible one. For this reason the use of hydro-electric energy should be encouraged in every reasonable way.

Further development of water-power in Canada will, undoubtedly, be extensive, and must depend very largely on:

1. Additional requirements for municipla, industrial, and domestic use.
2. Growth of pulp and paper industry.
3. New electro-chemical and electro-metallurgical processes.
4. Electrification of steam roads, especially terminals and adjacent engine divisions.
5. Substitution of hydro-electric power for fuel-power in manufacturing and industry.

In the rapid development within a short space of time of our water-powers to the extent of nearly 1,800,000 horse-power it is natural to expect that there has been some misconception in design. in construction, in conservation of opportunity, in overlapping of service, and even in governmental administration, although as to the latter it is an axiom in British jurisprudence that "the king can do no wrong." If we were starting de novo to develop our water-powers, with our present knowledge of what is essential in government investigation and administration, of what is really basic in conservation of resource, of the present practice of the art of hydraulic and electric engineering, and last, but by no means least, of what is the most important or prior market demand, from a national standpoint, from particular power sites, whether general municipal requirements should precede electro-chemical and allied industrial requirements, we would. for instance, most assuredly produce a very different power situation at Niagara. At the same time this most important and world-famous source of our electric energy has well served us. Generally speaking, our water-powers have undoubtedly proven to be one of Canada's most valuable assets.

Looking to the future in power development, if Canada is to reap full benefit from her heritage in white coal, there must be a constructive liaison between:

(a) The various Dominion and provincial government administrative departments concerned in water-power matters.

(b) The producing corporation or commision; and

(c) The consuming public.

Concurrently with such a liaison there must also be an adequate co-ordination of the development and use of water-power with that of all other power-producing agencies.

Anyone who has listened attentively to the very able presentation of the various elements in the fuel situation during the last two days must realize that there is a prodigious field for such co-ordination in the development and use of our varied power and heat-producing resources which will combine the effective use of all along lines for which each is best adapted, and which will, by avoiding duplication or misdirection of effort, promote the efficiency of both individual and conjoint use.

The necessity for the correlated development and use of all our fuel-power resources has surely passed the agitational or educational stage. The many urgent reasons for such correlated use are stressed a hundredfold by the coal shortage experience of this winter.

To visualize the interdependence and interrelation of all the fuel-power agencies available in Canada, and to offer something as a basis for general discussion, I have prepared a chart (Plate No. 4), which, if it indicates any one thing, it conclusively proves the immensity and complexity of the problems involved in effecting the co-ordinated, concomitant development and use of all our fuel-power resources. The chart shows that this can be best realized following the evolution of a national master fuel-power policy for all of Canada.

Gentlemen of the Canadian Society of Civil Engineers, are we going to leave this great problem in "the laps of the gods"? Is it not one of peculiar concern to engineers, and of such timely and pressing importance to Canada that we, as a society, would be warranted in attempting a solution? Should we not mark the enlargement of the scope, influence, and prestige of our society (which we hope is being exemplified by its transition to the Engineering Institute of Canada), by an earnest effort to evolve, in general terms, the basic principles of a national master fuel-power policy for Canada.

Electrification of Canada's Railways

By John Murphy*

Note.—The writer wishes to acknowledge his indebtedness and to publicly return his thanks to officials of the railways below mentioned and of the manufacturers of the apparatus referred to, as well as to the technical press from which much of the following material has been gleaned.

Still smarting from the sufferings of two successive winters' fuel shortages, caused by inadequate transportation facilities, we are foregathered to see what can and should be done to prevent, if possible, recurrences of such serious and trying experiences.

No argument is required, I think you will agree, to support the contention that eliminating the need for coal at a considerable distance from the mine is a greater measure of relief, and of truer conservation, than increasing mine production and thereby incidentally adding more load to the already overburdened railways. Reducing coal consumption automatically relieves or releases men and apparatus all along the route from the mine to the consumer—it also relieves the route itself from some of its congestion.

So eminent an authority as Mr. E. W. Rice, the President of the American Institute of Electrical Engineers, addressing that body in New York last month made the following statement:—

"It is really terrifying to realize that 25 per cent. of the total amount of coal which we are digging from the earth is burned to operate our steam railroads—and burned under such inefficient conditions that an average of at least six pounds of coal is required per horse-power-hour of work performed. The same amount of coal burned in a modern central power station would produce an equivalent of three times that amount of power in the motors of an electric locomotive, even including all the losses of generation and transmission from the power station to the locomotive."

Mr. Rice went on to say that 150,000,000 tons of coal, nearly 25 per cent., as he said, of all the coal mined in the United States, were consumed in steam locomotives last year.

Here in Canada steam locomotives also did their bit, and consumed about 9,000,000 tons—30 per cent. of the 30,000,000 tons of coal imported into and mined in this country. Our 9,000,000 tons cover, I believe, wood and oil consumed on steam locomotives; some 49,000,000 gallons of oil are covered by the Canadian record. But in the United States' figures 40,000,000 barrels of oil, 15 per cent. of the total output, are not included.

The conservation of—the elimination of the necessity for mining—those great quantities of fuel would be secured if all the railways were operated electrically, and if the electrical energy were generated from water power. Modern steam central stations would save from 50 to 66 per cent. of the coal now used in steam locomotives if the latter were discarded and electric locomotives used instead.

With such possibilities for fuel conservation in sight may we not soon expect to learn that the fuel controllers in both countries have asked the railways, and that the railway managers have asked their engineers:—"How many of these millions of tons of coal can you save—when will the good work begin?"

It is said our fuel shortages were due to a combination of bad weather and inadequate transportation. As we cannot control the weather our attention and efforts must be directed to the transportation portion of the difficulty. Railway electrification will reduce coal consumption and haulage; it will also greatly improve traffic conditions; electrification, therefore, seems to be the solution of the problem. Under these circumstances it may not be out of place to recite in general terms what electrification has actually accomplished on some notable railways.

Railroading in the mountains is the most strenuous kind of railway work. The examples which I have chosen cover mountain sections. The Butte, Anaconda & Pacific Railroad, by electrification, increased its ton-mileage 35 per cent., and at the same time decreased the number of trains, and their incidental expenses, 25 per cent. The time per trip was decreased 27 per cent. It is said their savings in the first year's operation, after electrification, amounted to 20 per cent. of the total cost of electrification. They buy power from Water power plants.

On the Norfolk & Western Railway power is obtained from their own steam station. Twelve electric locomotives have replaced 33 Mallets of the most modern and powerful type. The tonnage has been increased 50 per cent. Electrification obviated the necessity for double-tracking. The salvage value of the released steam engines was 45 per cent. of the cost of electrification. Electric locomotives make eight times as many miles-per-train-minute-delay as the steam engines. Their terminal lay-overs average 45 minutes, and they are double-crewed every 24 hours. Pusher engine crews have been reduced from 8 steam to 4 electric. Pusher engines or locomotives have been reduced from 7 steam to 2 electric. Steam locomotives used to "fall down" in cold weather—the electrics always "stand up," are really more efficient, in cold weather. At the New York Railroad Club meeting last year their electrical engineer stated that "coal wharves, spark pits, water tanks and pumps as well as roundhouses and turntables have all disappeared from the electric zone. Our track capacity has been doubled. Our operating costs have been reduced. From an engineering, an operating and a financial viewpoint our electrification has been a success."

Speaking of the value of the regenerative electric braking of their system he went on to say:—"The use of the air brake is practically eliminated, it is only used to stop trains; it is regrettable we are unable to put a dollars and cents value on this great asset; to appreciate it properly one must have had experience with the difficulties of handling 90 car trains with air." Another official, referring to the same subject, made the following statement:—"Trains of 103 cars are taken over the summit, 12 to 20 times every day, down the 2.4 per cent. grade without ever touching the air. We never broke a train in two or slid a wheel. It is done so nicely we wouldn't spill a drop of water out of a glass in the caboose."

The 440 route miles of the Chicago, Milwaukee & St. Paul Railway which have been electrified will soon be augmented by 450 miles more. Nearly 900 route miles and about 33 per cent. in addition for passing tracks, yards, industrial tracks and sidings will soon represent the extent of this great railway electrification. Among the advantages secured by this railway on its electric sections are the following:—The cruising radius of each electric locomotive is twice that of the steam engine. Sub-divisional points, where freight crews and steam locomotives were formerly changed, have been abolished; the passenger crews' runs are now 220 miles instead of 110. For railway purposes these stations do not now exist; 7 or 8 miles of track have been taken up; through freights do not leave the main line track at all; shops and roundhouses have disappeared along with their staffs, and one electrician replaces the whole old force. An electric locomotive has made 9,052 miles in one month. Although schedules have been reduced the electrics have made up more than 2½ times as many minutes as steam engines—time which had been lost on other divisions; 29 per cent. of electric passenger trains made up time in this manner. On a mileage basis alone the operating costs of the electrics are less than one-half the steam engine costs. Freight traffic increased 40 per cent. shortly after electrification—double-tracking would have been necessary to handle such increased business under steam operation. An average increase of 22 per cent. in freight tonnage per train has taken place. One electric handles about 3½ times as many ton-miles as a steam engine; the reduction in time in handling a ton-mile is 30 per cent.; faster and heavier trains have accomplished these results, the number of trains has not been increased. About 11½ per cent. of the energy used by the railway is returned to the line in the process of regenerative braking, and this returned energy helps to haul other trains. While this is a very important item and reduces the power bills, it is only regarded by the management as of secondary importance in comparison with the more safe and easy operation of trains on the grades and the elimination of former delays for changing brake shoes and repairs to brake rigging when operating with steam locomotives. The electrics maintain their schedules much better than steam engines. In three months the electrics only waited for the right of way 254 minutes, while the steam engines in a similar period waited 1,910 minutes or 7½ times as long. Extra cars on trains only delayed electrics 1/9 of the time steam trains were delayed for a similar reason. Cold weather delayed steam trains 445 minutes in the three months under discussion, but the electrics were not delayed a minute; the latter are more efficient in cold weather. Many of the delayed steam trains were double-headers—never more than one electric is hitched to a passenger train. An entire suspension of freight service, due to steam engines losing their steaming capacity and freezing up was not an uncommon experience. Electrical energy for the operation of these trains costs considerably less than coal. This latter statement is one of the most interesting in connection with the operation of the C. M. & St. P. Ry. and it is especially interesting because it was made more than one year ago.

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The limitations of the steam locomotive are due to the fact that it is a mobile steam power plant of very limited capacity; it is compelled to carry its own supply of coal and water ,and it is unable to take advantage of many of the economical refinements of the large modern stationary steam plant. On the other hand, the electric locomotive has no such limitations; it merely acts as a connecting link between efficient gigantic stationary steam or water power plants and the train to which it is connected. The Electrical World summed up the situation a short time ago when it said:—"Why continue to haul millions of tons of coal, for and by uneconomical steam locomotives, all over the country, and thus add more loads to the already over-burdened railways, when the power which they need so badly can be much more economically and efficiently transmitted to electric locomotives over a wire the size of one's little finger?"

The continual increasing cost of coal and fuel oil will force railway managers to look more and more carefully into railway electrification. Estimates of a few years ago now need revision. Money may be hard to get, but, if at times fuel cannot be obtained at all, some substitute must be obtained if normal life is to be continued in northern latitudes.

A representative of the National City Bank of New York, writing of the period after the war, referred to the stagnation which may ensue in all the great industries now engaged in war work as soon as peace is declared; the multitude of people thus thrown out of work, in addition to the men of the returning armies, would create unbearable conditions unless suitable employment will have been arranged for them in advance; he referred to the economic advantages of railway electrification and was of opinion that this work might solve the whole question if soon taken up with vigor. The Minister of Public Works, Hon. F. B. Carvell, M.P., addressing the Ottawa branch of our organization a couple of weeks ago, spoke of the necessity of conserving the energy of our water powers—instead of letting them run to waste—so that this great store of energy might be employed in assisting to build up our own and to rebuild other countries when peace comes. How nicely these two ideas, water power development and railway electrification, work together if properly carried out?

With the view of securing something really worthy of presentation to this important meeting I recently wrote an eminent engineer, a man of international fame, and recognized as an authority on railway electrification, requesting him to tell me his own views upon this subject. A specialist's opinion, in my opinion, is always very valuable. Here is a short extract from his interesting reply. He said:—"Generalization is always dangerous, especially in connection with electrification of railways, where so many factors, such as the physical location, character of loads, the power situation, etc., come in to affect the decision if applied locally." From his sober statement it may be seen that my correspondent is an engineer—not a politician. He proceeded as follows:—". . . . with present equipment prices the cost is absolutely prohibitive." This opinion, let me point out, is in connection with the proposal to "electrify everything." Do not let it dampen our enthusiasm. Listen to this also and kindly keep it in mind; it is another extract from the address of Mr. E. V. Rice, above referred to. He said:—"I think we can demonstrate that there is no other way known to us by which the railroad problem facing the country can as quickly and as cheaply be solved as by electrification."

While the present fuel shortage questions have made us look to railway electrification for relief I feel such a project on a large scale can only follow or go hand in hand with power plant development and co-operative operation of power plants. The location of a number of plants at different points —large water power plants and auxiliary steam plants—so situated and inter-connected that a failure at one plant or the connections to it will not jeopardize the others or completely cut off and isolate an important railway district is, in my opinion, an essential feature in connection with any large railway electrification project.

The 99-year contract of the C. M. & St. P. Ry. is worthy of more than a moment's attention and consideration in this discussion. That railway has a contract with a power company which has a series of plants stretching across the country parallel to the railway. The railway owns its substations and secondary lines but is not concerned with the high tension lines of power plants of the power company. A reasonable rate for power arranged between a willing purchaser and a willing seller—a contract in fact which each party knows the other will respect—is the basis and the real reason for that great railway electrification. Neither party questions the other's integrity or financial soundness. One delivers the power it has undertaken to supply and the other uses it. The arrangement is ideal in its simplicity and entirely satisfactory to everybody concerned. It will, in my opinion, be necessary to have such attractive power-supply situations as those outlined above, backed by abundant supplies of power, in order to foster and encourage early railway electrification work in this country.

Joint Committee of Technical Organizations

Holds Annual Meeting — Chairman Alfred Burton Reviews Year's Activities Before Large Attendance

To the Technical Men of the Province of Ontario:

Gentlemen: Your committee has pleasure in submitting its second annual report, covering activities during the period elapsed since our first annual meeting in March, 1917. Meetings of the joint committee have been held monthly during the year to hear reports from the executive, deliberate on questions of policy, and appoint and instruct sub-committees. The executive committee have held about 40 meetings.

Finances

Up to September, 1917, the expenses of the joint committee were carried entirely by private subscription. Since that date, largely owing to the generous recognition of services rendered to the Imperial Munitions Board, we have had less difficulty in defraying our running expenses. The chief items consist of the rental of a small office, the salary of a stenographer, and the cost of printing, postage. etc.

Changes in By-Laws

A slight alteration has been made in the wording of our by-laws so that the committee now includes a representative from the Canadian Manufacturers' Association.

This was deemed highly desirable on account of the close relationship existing at the present time between the technical and industrial activities of our country. The wisdom of this addition has been amply justified in the valuable assistance the representative of that association has rendered your committee.

Inventions

One of the most important activities of your committee, and one which we are pleased to feel has been of real assistance to the Imperial Munitions Board, has been the study of the various and varied inventions submitted to that board from all over the continent. These inventions, in the main, have reference to war activities, such as improvements in aeroplane design, detection of submarines, etc. Some idea of the amount of work entailed may be gained from the fact that detailed reports have been made to the Imperial Munitions Board during the past year on almost 100 inventions. This work has been handled through the medium of a special subcommittee, whose work is deserving of a very grateful and special mention.

Aviation

A sub-committee has been formed for the study of aeronautical problems. The work of this committee, which is of recent creation, has consisted to date in compiling information, and, in general, getting in touch with the various phases of the work through correspondence and personal interviews. It may be too much to expect that this committee will be enabled to carry out any experiment which will have any direct bearing on maintaining the supremacy of the Allies in France, but such a group of men, with intimate knowledge of the subject of aeronautics, will be an invaluable asset to Canada in the future development of aeroplanes. for which there is certain to be an increasing demand, quite independent of the duration of the war.

Depletion of Civil Ranks of Engineers

A survey of the engineering departments of our Canadian universities has demonstrated, during the past few months, that, due to war demands, the ranks of engineers are being depleted much faster than they are being recruited from the universities. As an instance, it may be mentioned that in one of our universities the present attendance in the science department is only about 15 per cent. of what it was in 1914. This state of affairs will not only be fatal to the proper prosecution of the war if it should last much longer, but it will leave us unprepared to take our part in the great engineering construction activities that must follow the cessation of hostilities.

Having this in view, your committee has considered ways and means of increasing the attendance in the engineering faculties, and in the very near future will have a definite, concrete proposition to offer. It will probably involve the expenditure of a few hundred dollars per year. How this money can be raised has not yet been determined, but, if not otherwise available, we have every confidence that the technical men of the province can be depended upon to supply the necessary funds for a cause so urgent at this moment and so much in line with our natural sympathies.

Technical Men Being Used Inefficiently

A phase of the technical situation having a direct bearing on the last item is the inefficient use that has been made of trained technical men in the past by placing them in the infantry ranks or in other war work where unskilled men would have been almost equally effective. When the present Military Service Act came into force your committee again took occasion to call the attention of the proper government authorities to this waste and to urge that engineers in future be utilized in such work as their special training best fitted them to perform.

Catalogue of Technical Books

Your committee has discussed the probable value to the average technical men of a catalogue of all the technical books to be found in the various libraries, both public and private, in Toronto and possibly including libraries in other cities. Such a catalogue exists with regard to magazines, but there is nothing of this nature covering books. The matter, as most of us are aware. has been the subject of discussion in all the various technical organizations which have representation on this committee, and has met with their approval in every case. It remains now to determine the best means of accomplishing the desired end with such assistance as we have at our disposal.

Questionnaires

The work on questionnaire No. 3, which was undertaken by your committee for the Advisory Council for Industrial Research, and which was under way at our last annual meeting, has been completed. Assistance has also been given with questionnaire No. 4 to the extent of supplying the Advisory Council with our list of Ontario's technical men and in other minor matters. Your committee also assisted in the preparation of a questionnaire recently submitted by the Canadian Manufacturers' Association to their members re power shortage.

Training the Blind for Mechanical Work

It is inevitable that many of our brave fellows will return to Canada, during and after the war, afflicted with total blindness. A foretaste of this problem was seen in the recent Halifax disaster, in which so many lost their sight. It is, of course, common knowledge that in Great Britain very considerable progress has been made in training the totally blind to do mechanical work, and some progress has been made in the United States in the same direction, more notably in winding standard coils. Your committee is gathering all available information on this subject, so that it may be ready to pass along to the proper authorities. It is not entirely apparent how the practices of Great Britain and the United States can be followed or developed in Canada, where the amount of purely repetition work, such as coil winding, mentioned above, is comparatively small, but we believe the question is well worth further study.

Lists

Our original lists of technical men have been kept up to date as far as is humanly possible, and, at the present time, are undergoing a complete revision and verification. These lists have proven of the greatest value on numerous occasions, for, although it is understood that they are kept strictly confidential. we have nevertheless been able to compile from them from time to time smaller special lists for different government and war activities which, we feel quite satisfied, have repaid us all for any trouble we may have been put to in their preparation.

Vocational Training

During the early part of the year your committee was actively interested in the matter of vocational training of returned wounded soldiers, and it is with some feeling of pride that we report the selection of a member of your committee as the administrator for Canada of the vocational branch of the Military Hospitals Commission, now the Invalided Soldiers Commission. I am pleased to note that the administrator himself is with us this evening, and, as your program has already announced, will tell us of the work being done under his able organization.

Other Activities

At the time of the Halifax disaster your committee, cooperating with the Toronto Chapter of the Ontario Association of Architects, made offers of assistance in an advisory capacity to both the Commission of Conservation, Ottawa, and to the Halifax Relief Commission, Halifax. On account of the almost complete destruction of certain parts of the city it was felt there might be opportunity to rebuild at least a portion of the devastated area along predetermined lines, so as to produce something in the nature of a model city. Another matter in which we have lent our assistance is recruiting for the Canadian Engineers. I may say, also, that we have been entrusted with certain other work, about which it would not be wise to make public mention at the present time.

In Conclusion

In conclusion, I should like to add my word of appreciation of the work of the members of the joint committee, every one of whom has given freely of his time. ability and experience in the earnest hope that our little endeavor to lighten the load under which the Empire labors may not be fruitless. In this hope—that we have helped, even ever so little, to bear this burden—lies the recompense dearest to the heart of every true engineer.

At a board of trade conference in Brantford recently it was decided to ask the Dominion Government to take quick and effective action on connection with the improvement of Port Dover harbor. Representatives were present from Brantford, Paris, Galt, Waterford, Preston, Kitchener, Simcoe, and Port Dover. The municipalities favor an open harbor, under control of the Dominion Railway Board, doing away with Grand Trunk control. The conference also unanimously adopted a resolution calling for a car ferry service across Lake Erie to Erie, Pa., ensuring a considerable reduction in coal rates to all points in the district and avoiding congested terminal points on the all-rail route.

Mainly Constructional

East and West—From Coast to Coast

The County of Oxford, Ont., has voted $10,000 for road repair work this year.

A recently received report states that material is being delivered for the construction of the new school at Rossland, B.C. This building will cost about $80,000, and will be pushed to completion as rapidly as possible when the weather permits.

Reports state that the military authorities will take over the property of Lieut.-Col. Cunningham, at Kingston. Ont., now used as a convalescent home, and erect a hospital for the care of men invalided home to that district. Present plans are to provide accommodation for 1,000 men.

The ice jam on the Cherry Mill dam at Preston, Ont., when breaking up became wedged against the Grand River railway bridge, necessitating the use of dynamite by the railway company. Two of the trestles gave way under the impact, causing the centre of the bridge to collapse.

The offer recently made to Sarnia, Ont., by the Imperial Oil, Ltd., to construct, at its own expense, an asphalt roadway 24 ft. wide and one mile in length on Mitton Street, has been accepted, and work will be proceeded with shortly. The company will not spare expense in making the road a model of its kind.

The Imperial Oil, Ltd., recently took out a permit to erect a bulk storage station for petroleum products on the south side of Keating Street, Toronto, at a cost of $104.200. Another large building now contemplated in this city is a six-storey concrete structure for Fairweathers, Ltd., to be erected on Yonge Street, at a cost of about $150,000.

Estimates totalling $1,750,000 have been passed by the Toronto Harbor Commission in order to carry on their work during the year. The operations will mainly consist of dredging, which accounts for $650,000, and will create revenue-producing property. The balance of the $1,750,000 is largely required to meet fixed charges. Under the powers granted by the legislature, the commissioners will borrow out of the sinking funds of the city to the extent of about $975,000 this year.

The Dominion Government estimates for public works in the Province of Ontario total $607,800, of which revotes amount to $180,300. Every item is in connection with the completion of buildings already under construction. Not a new building is authorized. For harbors and rivers in this province the vote, exclusive of the Toronto harbor, is $252,315, the main items being $77,000 further for Port Stanley harbor improvements, $40,000 for repairs to Langevin pier, $14,000 for repairs to piers at Port Burwell, $7,400 for repairs to breakwaters at Port Colborne.

At its present session the Dominion Government has voted $1,860,000 for the Welland Ship Canal, $500,000 for the Trent Canal, $700,000 for the Quebec Bridge, and $250,000 for the National Transcontinental Railway. Public works votes chargeable to capital include an additional $1,500,000 to cover the cost of construction of the new Ottawa parliament buildings and $1,000,000 for the new departmental building at Ottawa. Harbor and river votes under the same head include $350,000 for improvements at Port Arthur and Fort William, $150,000 for Vancouver, and $166,000 for Victoria. The total vote for public buildings chargeable to capital is $2,620,000. an increase as compared with $2,125,000 for the current fiscal year. On the other hand, harbor and river votes chargeable to capital will decrease from $5,931,000 to $1,836,000.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Glace Bay, N.S.
Town Council contemplate repairs to reservoir. Engineer, A. McKinnon. Clerk, N. F. McNeil.

Town Council contemplate the installation of a 2,500,000 gallon capacity per day waterworks pump. Engineer, A. McKinnon.

Halifax, N.S.
Tenders will be received by the secretary, J. W. Pugsley, Department of Railways & Canals, Ottawa, until April 13, for the construction of sewers and watermains for the Canadian Government Railways, Ottawa.

Lindsay, Ont.
The Victoria County Council will expend $34,000 on roads this summer and will purchase a quantity of good roads machinery. Mr. Martindale, Oakwood, is chairman of the Good Roads Committee.

Maidstone Township, Ont.
Tenders received by the Clerk, A. Mousseau, Woodslee, until April 8, for the construction of the Powers drain for the Township Council. Engineers, Laird & Laird, Essex.

New Waterford, N.S.
Town Council contemplate the construction of sidewalk, curb and gutter costing $7,000 on Plumber Avenue. Clerk, J. L. McKinnon.

Toronto, Ont.
Tenders received until April 16 for the installation of a 5,000,000 imperial gallon pump at the Riverdale pumping station for the Board of Control. Secretary, Thos. McQueen.

Virden, Man.
Tenders will be received by the secretary-treasurer, Wm. Whiteford, until 6 o'clock, April 12, for 37 miles of road grading, laying pipes of 37 miles of road and two double 3 ft. x 5 ft. reinforced concrete culverts for the Town Council.

CONTRACTS AWARDED

Amherstburg, Ont.
The Foundation Co., Ltd., 224 St. James Street, Montreal, have the contract for the erection of a reinforced concrete and brick pump house, and the Canadian Bridge Co., Ltd., Walkerville, the contract for the erection of a steel boiler house for the Brunner Mond Co. and the City Council.

Dereham Township, Ont.
Jas. Dawson, care of township clerk, Alex. Bell, Dereham Centre, has the general contract for the construction of a Rutherford drain costing $3,000 for the Township Council.

Leamington, Ont.
F. R. Smithson, Erie Street, has the general contract for the construction of the Gregory drain for the Town Council.

St. John, N.B.
B. Mooney & Sons, 112 Queen Street, have the general contract for the construction of pavements for the City Council.

Railroads, Bridges and Wharves

Halifax, N.S.
Tenders will be received by the secretary, J. W. Pugsley, Department of Railways & Canals, Otawa, until April 13 for the erection of transit sheds and temporary passenger station for the Canadian Government Railways, Ottawa.

Tenders received by the secretary, J. W. Pugsley, Department of Railways & Canals, Ottawa, until April 13 for the erection of a baggage car repair and express building for the Canadian Government Railways, Ottawa.

Tenders will be received by the secretary, J. W. Pugsley, Department of Railways & Canals, Ottawa, until April 18 for the construction of a reinforced concrete subway for the Canadian Government Railways, Ottawa.

Montreal, Que.
The Montreal Southern Counties Railway Company, 95 McGill Street, are preparing plans for the erection of station, freight, express and general offices on Youville Street. General manager, W. B. Powell, 95 McGill Street.

New Westminster, B.C.
Plans have been drawn and tenders will be called shortly for the construction of a $1,000,000 jetty at the mouth of the Fraser River for the Department of Public Works, Dominion Government. Engineer, C. C. Worsfold, New Westminster. Secretary, R. C. Desrochers, Ottawa.

Stormont, Dundas & Glengarry Counties, Ont.
Specifications, etc., are at the office of the superintendent, J. G. Cameron, Finch, who will receive tenders until April 12 for painting bridges for the County Councils.

Vancouver, B.C.
The Waterworks Department, City Council, contemplate the construction of a $15,000 dam at Capilano River. Engineer, F. L. Fellows.

Plans are being drawn for a $7,500 wharf and landing slip at the foot of Gore Avenue for the Engineering Department, City Council. Engineer, F. L. Fellows. Clerk, Wm. McQueen.

Public Buildings, Churches and Schools

Bathurst, N.B.
Tenders will be called by the architect, W. C. Barnes, Main Street, Moncton, about June 1, for the erection of a $20,000 hospital for the John H. Dunn Hospital Board.

Camrose, Alta.
Tenders are about to be called for the erection of fair ground buildings for the Town Council. Clerk, J. D. Saunders.

Dartmouth, N.S.
The United States Red Cross, Merchants Bank Bldg., Halifax, contemplate the erection of a hospital.

Fitzroy, Ont.
Millson & Burgess, Union Bank Bldg., Ottawa, are preparing plans for a school for the Public School Board.

Magog, Que.
The Roman Catholic Congregation will rebuild church tower. Priest, Rev. F. X. Brassard.

Montreal, Que.
Alphonse Piche, 33 Belmont St., is preparing plans for repairs to convent for the Grey Nuns. Address, Rev. Sister La Framboise.

Ottawa, Ont.
The City Council have secured a building at Cooper and Cartier Streets which they will remodel at a cost of $6,000, for a club house for the Great War Veterans. Clerk, N. H. Lett.

Oyen, Alta.
Tenders will be called about April 30 for the erection of a $17,000 three-storey brick school for the Board of Trustees, School District No. 3058.

Pabos Mills, Que.
Plans and specifications with the architect, P. Levesque, 115 St. John Street, Quebec, who will receive tenders until April 10 for the erection of an $8,000 two-storey Citadel brick presbytery for the Parish.

Regina, Sask.
The City Council contemplate the erection of an auditorium, etc., costing $180,000. Clerk, Geo. Beach.

Saint Anges, Que.
Plans and specifications are with the architect, Lorenzo Auger, 39 St. John St., Quebec, who will receive tenders until April 12 for the erection of a $12,000 two-storey artificial stone presbytery for the Parish.

Saints Anges de Cascapedia, Que.
Tenders will be received by the architect, P. Levesque, 115 St. John St., Quebec, from about April 25 until May 10 for the erection of a $10,000 presbytery for the Parish.

St. Cyprien, Que.
Tenders will be received by the architect, Lorenzo Auger, 39 St. John Street, Quebec, from April 8 until April 19 for the erection of a $50,000 church for the Parish.

St. Hyacinthe, Que.
Tenders will likely be called about April 25 for the erection of a $6,000 hospital for the Grey Nuns. Architects, Rene Richer, 10 Cathcart St.; Montreal,

ESTABLISHED 1886

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The Gambling Element in Letting Contracts

At a meeting of the Massachusetts Highway Association, recently held, the following resolutions were passed scoring collusive bidding:

Resolved, That in the opinion of this association, when in competitive bids any item is offered at manifestly less than its actual cost, such bid should be rejected as "unbalanced," unfair, and against the interest of the municipality.

Resolved, That in the opinion of this association, when the same person, or persons, are interested in two or more bids made in different names, in competition for the same work, all of such bids should be rejected as collusive and against the interests of the municipality.

In the discussion it was shown that in the city of Chicago a few years ago a contractor bid one cent per square yard for concrete foundation costing about 80 cents per square yard and bid an exorbitant price for asphalt pavement surface. Comparatively little concrete foundation was laid, and the acceptance of this unbalanced bid cost the city of Chicago hundreds of thousands of dollars more than would have been the cost if the next fairly balanced bid had been accepted. Apparently the municipal authorities accepted this unbalanced tender believing that they were securing the best deal, but why they failed to analyze the cost or why the relative quantities of concrete foundation and asphaltic surface were not clearly set forth are matters that might have been explained.

Contractors are often compelled by the systems in vogue to resort to such practices as offering a dollar article for 99 cents, and reliable contractors have very often to take work practically at cost or less in order to secure business and retain their organization. There is no question that the calling for lump sum competitive prices and the final acceptance of apparently the lowest price which, in a large percentage of cases, is absurdly unbalanced, is very poor business on the part of the owners. A much better way, both for the owner and the contractor, and a way to promote clean competition, is to let work on a guaranteed cost and percentage basis or a lump sum representing the contractor's profit. If this system were universally employed, contracts would then be awarded on the merit of the competitors, and their ability to do work more economically and better than others would be the basis of letting the work.

The Contractor's Opportunity to Aid in Production

The following letter from Mr. J. P. Anglin, president of the Montreal Builders' Exchange, throws a little more light on the matter of greater production by utilizing contractors' organizations introduced in a recent issue of the Contract Record. Any contractor who feels that he can help in this splendid work is urged to get in touch with his nearest exchange. Mr. Anglin's letter reads:

Editor Contract Record:

I have been personally working on this project, without any let-up, for over six weeks, and it looks as though it would develop into one of the largest wheat-growing plans that has yet been attempted. Its success seems assured, providing we can get on the ground early enough this year to break it for the crop next year. The question of financing this great project is now being seriously considered, and if this can be arranged there is absolutely no doubt of its success.

I thought that I should write you in case any contractors who might see the article would be sufficiently interested in the game to wish to get in on the ground floor and develop a number of sections on their own account. In order to guarantee the contractor against loss all contractors going in should work on the co-operative basis, so that, should crops fail in a few sections, the loss would be distributed over all of the contractors, and in this way no one could lose and yet everyone would be assured of large profits.

In order that the contractors may seriously consider the amount of acreage they could develop, I am giving you a few figures regarding definite area. The smallest unit which could be undertaken profitably by one contractor would be 4,000 acres. Of the 4,000 acres the contractor should crop 3,000 acres in 1919 and about 2,500 acres annually thereafter. The reason for fixing the smallest unit at this size is that one threshing machine will take care of this area, and the contractor can, therefore, be independent of outside threshing concerns.

Any contractor who would care to seriously consider going into this project and operating one or more such units as outlined above should at once link up with the nearest builders' exchange or write direct to the Montreal Builders' Exchange, Drummond Building, Montreal. I might say that I have already received some very encouraging letters from construction men in different parts of the country, and there is every indication that those of us who have been forced to stay at home, because of circumstances, will be able to do our bit in helping to win the war and to avert a famine in many parts of the world.

Yours very truly,
J. P. Anglin.

C. S. C. E. Meeting in Montreal

THE Gzowski medal, awarded by the Council of the Canadian Society of Civil Engineers to Mr. W. F. Tye, past president, for his paper on "Canada's Railway Problem and Its Solution," was presented to that gentleman at a meeting of the society at Montreal, on March 28.

Sir John Kennedy, in making the presentation, stated that Mr. Tye had written a masterly paper on a subject with which, as a railway engineer, he was fully qualified to deal. Mr. Tye had conferred distinction on himself and on the society in making this contribution.

Mr. Tye expressed his thanks to Sir John for his kind remarks and to the society for the honor conferred on himself. He certainly had not expected it, and appreciated the recognition of the society.

Mr. Fraser S. Keith, the secretary, stated that he was continually receiving applications for the paper from all classes of the community.

The convention at Toronto was referred to by Mr. H. R. Safford, chief engineer of the Grand Trunk Railway, who remarked that it was an epoch in the relations of the engineers of Canada to the public, by the discussion of public problems, and by giving the benefit of such deliberations to the country. This was the best meeting the society ever held. Mr. Safford made particular allusion to the many valuable papers presented and to the discussions which followed.

Mr. Fraser S. Keith read a summary of the papers at the convention and of the many suggestions for the amelioration of the fuel situation.

Mr. Walter Francis, who presided, then reported progress in connection with the Montreal branch. He stated that some committees had been appointed and steps taken for the formation of various sections. In co-operation with the Quebec branch, it was proposed to take immediate measures for the formation of a Quebec division. Mr. Francis then alluded to certain difficulties which had arisen in reference to the Quebec Act of the society, and which were engaging the attention of the committee. He also alluded to the recent act passed by the Quebec Legislature, which was in no way promoted by the society, for enforcing penalties against civil engineers illegally practising; and also to the clause under which civil engineers, not being members of the society were allowed to practise provided that they had been in practise for four years prior to December 1, 1917. The committee were taking certain steps to overcome the difficulties which had arisen, and to make rectifications in the Quebec Act of the society.

Sir John Kennedy advised the committee to proceed with caution.

Mr. Francis said there was an undoubted general feeling in favor of engineers being protected by legislation. Some action had already been taken by the council.

Replying to Mr. A. D. Swan, Mr. Francis stated that they were advised that such matters came within the provincial domain and were not subjects for federal legislation.

Building Superintendence in War Time

By Charles Taylor

AT no time in the history of the trade, owing to the war and general upset in things, has the occasion called for more resourcefulness or latent ability on the part of superintendents and managers of construction. The fact cannot be disputed that our best men have gone into the war, those who would have taken the lead and those who were the most active and alert. A class of workers are on the market who would have been at a discount before these war conditions. It has remained for the unfortunate manager to have to deal with this class largely. The first-class mechanics, as before stated, if they have not gone into the army, have, at any rate, disappeared from sight. These men, in most cases, had learned their trades in the old land thoroughly, and it is rather to be deplored that while the unions have been so busy arranging hours of labor, wages, disputes, etc., little was ever done to keep the supply efficient. and if it had not been for the efforts of public spirited men who have advocated trade and technical schools we would be worse off than ever.

Incompetent Boosters

We often hear the remark, in referring to the shortage of skilled men: "You can get the men if you pay the price." I venture to submit this is false; the men you would get if you pay the price are the class I have mentioned before—incompetent boosters, men who have by the situation named acquired cheek. Under the above conditions—and the writer is speaking from long experience—it has been impossible to make any money, and money has been lost on nearly every job taken by contract, which was estimated even on a good chance of profit, and away ahead of previous prices. We all know lots of things have entered in to make the costs higher—materials, delivery, etc.—but I am dealing with labor at this time only. Well, the reader will say after this apparently pessimistic arraignment of the above undisputed facts, what are we to do or what do you propose as solution. It is no doubt true that in the past some managers have had a too easy time—that is, the hard-worked, trustworthy underforemen and superintendents have, like the sergeants in the British army, been the backbone of the concern, in the sense of pushing the work and taking the brunt of the responsibility. That time is gone, and it is now up to the managers, etc., to get out and hustle themselves, and to scheme ways and means to assimilate the conditions. The manager has found out he has got to really manage, not delegate it to others; also that more time has to be spent in detail and arranging the several kinds of work. Do the thinking; have a pattern or plan of every man's work. Do not spare yourself; scatter your brains everywhere; leave nothing to chance; forget you ever had understudies to do your work; work harder than ever, then watch the results.

General Superintendent, Raymond Construction Company, Limited.

A memorial tablet to the late Professor C. H. MacLeod, for so many years secretary of the Canadian Society of Civil Engineers, has been placed in the lobby of the society's headquarters, Mansfield Street, Montreal.

General view of La Loutre dam—Nov. 5, 1917.

The Construction of La Loutre Dam

Transportation Presents Big Difficulty—Electric Operation of Plant Saves Fuel Haulage—Storage Capacity 160,000,000,000 Cubic Feet

By J. B. D'Aeth*

IN 1912 the Government of the Province of Quebec formed the Quebec Streams Commission, one of its purposes being that of investigating the requirements and building such works as would conserve the water-power of the province.

The first investigation carried out by the commission was for the La Loutre storage, on the St. Maurice River. This river has at its source a large number of lakes, lying near the height of land which divides the St. Lawrence watershed from that of the Hudson Bay. At the lower end of the river there are several large factories and hydro-electric plants, chief of which are the Shawinigan Water and Power Company, the Laurentide Company, Ltd., the Brown Corporation, the Wayagamack Pulp and Paper Company, the Belgo Canadian Pulp and Paper Company, the Aluminum Company, etc. The importance of conserving the waste waters of this river can, therefore, be readily understood.

In the spring of 1915 all the investigations and plans were completed for the construction of a solid gravity dam, to be built on a site about two miles and a half above the La Loutre Rapids and at the lower end of the lakes.

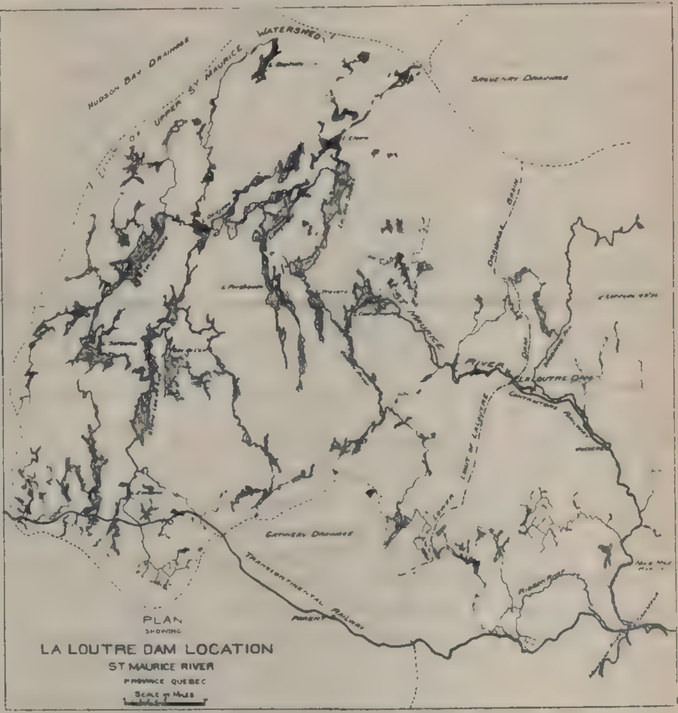
Tenders were called for in July, and the contract was awarded to the St. Maurice Construction Company, Ltd., who agreed to complete the job by January 1, 1918, and to accept thirty-year Province of Quebec bonds in payment for their work. Fraser Brace & Co. acted as supervising engineers.

It was generally recognized by those familiar with the location that transportation would be the chief and most difficult problem to solve. As will be noted from the accompanying plan, the dam is situated about 50 miles north from the Transcontinental Railway and in a fairly rough country. The contractors employed a double system of water and railway transportation. From the Transcontinental Railway at Sanmaur, about one mile below the junction of the Manouan and St. Maurice Rivers, the company laid a siding to the river. A small station was built, a yard cleared, and camps, storehouse, and wharf constructed. Here the cars were taken direct to the water-front, where they were generally unloaded into skip boxes, which were handled by a derrick and placed on scows. The scows were then towed 32 miles up the river to Chaudiere by means of light-draft tugs.

From Chaudiere to the dam, a distance of 20 miles, a standard gauge railway was built. At Chaudiere a wharf, storehouse, and camps were constructed, the goods were transferred and loaded on cars by means of a derrick, and taken to the dam site on the railway.

In the water transportation many difficulties were encountered. The channel had to be properly buoyed, rocks blasted, suitable scows and tugs secured for navigating in shallow water, and a quick and reliable method obtained for hauling the loaded scows up the Nine Mile Rapids.

It was found that the type of boat best adapted for this class of work was a shallow draft, stern paddle-wheel steam tug. These boats did not draw more than two and a half to three feet when loaded. The scows, which were towed two or three at a time, were between 60 and 80 feet long, and with a beam of from 12 to 14 feet. They were steered by means of a long sweep rudder, operated by a pilot on board. At the Nine Mile Rapids an alligator steam tug was employed to pull the scows up the swift current, while the tugs



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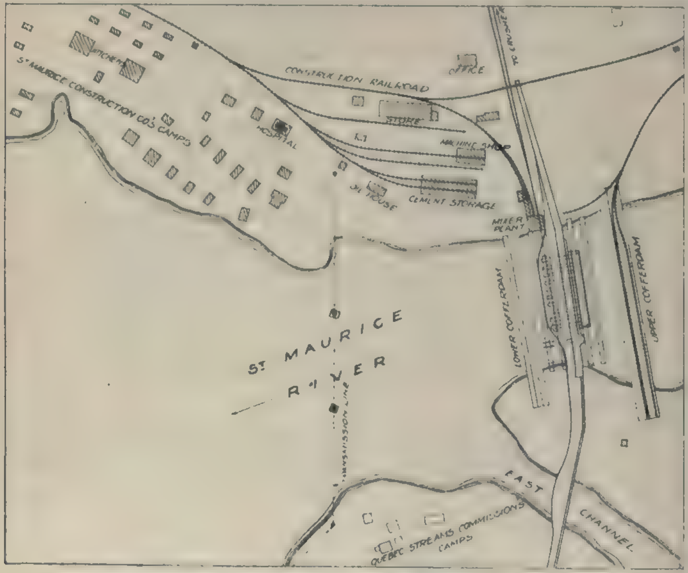
* Engineer, Quebec Streams Commission.

went up light. The company had a fleet of 31 boats, consisting of 2 stern paddle-wheelers, 1 alligator tug, 1 heavy duty gasoline tug, 1 twin screw steam tug, 6 gasoline boats, and 20 scows.

The construction of the 20-mile standard gauge railway between Chaudiere and the dam site was commenced in the fall of 1915 and completed during August of the following year. For operating this railway and for general use about the dam the company employed two 40-ton dinkeys, two of 27 tons, and two of 25 tons, 26 flat cars, two box cars, two 5,000-gallon oil cars, 35 six-yard dump cars, and a gasoline speeder. In order to avoid forest fires as much as possible oil was burned in the locomotives instead of coal during the summer.

To save the heavy transportation of coal, the entire plant at the dam site was operated electrically. A 700 kw. hydro-electric station was built at La Loutre Rapids. The plant was designed to operate under a 15-foot head, and consists of two units. The turbines are of the wicket-gate type, and were supplied by S. Morgan Smith. The generators are of 350 kw. capacity, three-phase, 60 cycles, 2,300 volts, and were supplied by the Westinghouse Company. A two-circuit transmission line, two miles in length, connect the plant to the dam site, where the voltage is stepped down to the requirements of the various motors, etc.



Showing location of construction camps and general plan of dam.

At the dam site there was a good general arrangement of the plant. A quarry was located high on the western bank. After blasting, the stone was loaded by a No. 60 Marion steam shovel into side dump cars, which were hauled up an incline and the stones dumped into a 54 x 30 in. Buchanan jaw crusher. From this it passed direct to a No. 7½ Telsmith gyrotory crusher, and the stones were then conveyed by an 80-foot link-belt elevator to a housed-in storage pile, which was raised sufficiently to permit the stones to flow into cars operated on the gravity system. These cars worked on double tracks, and conveyed the stone to the mixer plant, where it was deposited into bins directly above the concrete mixers.

A high quality sand was found along the railway, about six miles from the dam. It was loaded by another No. 60 Marion steam shovel, brought direct to the mixer plant and deposited in bins.

A cement shed 40 x 200 feet long stored cement at the dam and a smaller reserve shed was kept filled at Chaudiere.

During the winter 1915-16 approximately three and a half million b.m. of logs were cut in the vicinity of the dam. They were used for trestles cribs, coffer-dams, and lumber. For the latter purpose a fully equipped 50 h.p. sawmill was erected, with a carpenter shop adjoining.

A very complete machine and blacksmith shop was installed, in which almost any repairs could be made. The installation included three forges, two lathes, a drill press, pipe-cutting and threading machines, etc. An Ingersoll-Rand air compressor, with a capacity of 1,100 cubic feet per minute, working at 110-pound pressure, and driven by 200 h.p. motor, supplied air to the rock drills and cable-way engine. All the derrick engines, pumps, and concrete mixers were driven electrically. A storehouse 40 x 150, divided into hardware and grocery, supplied the urgent needs of the community. A post-office was also run in conjunction with it.

As will be seen from the accompanying plan, an island divides the river in two channels. The general plan of construction was to prepare the east channel foundation and bring the concrete above high-water level, at the same time leaving sufficient openings to carry off the spring floods, and in 1917 to complete the structure. Accordingly, in the early summer of 1916, two coffer-dams were thrown across the east channel and that portion of the foundation unwatered.

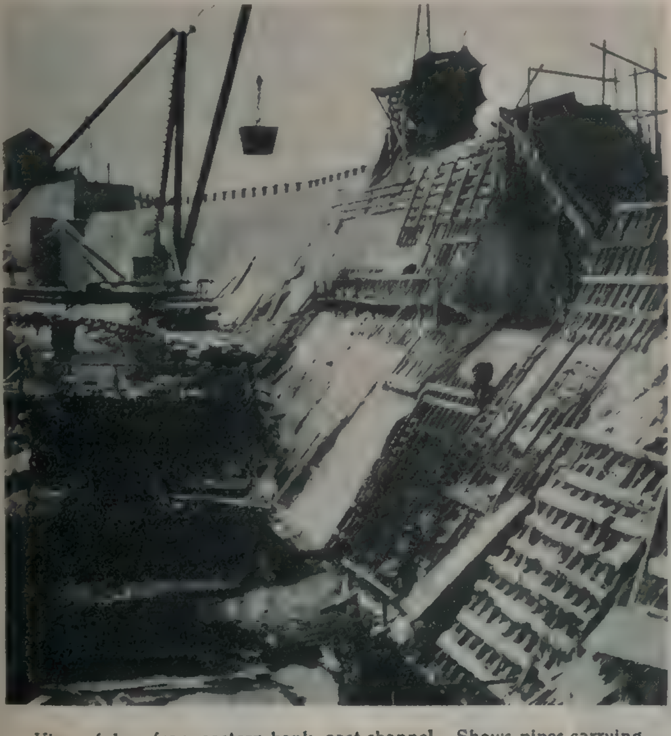
Looking west along the sluice, section showing the ten sluices in position, the mixer plant, construction trestle, travelling derricks and crusher plant on side hill.

Excavation began on the 1st of August, and the first concrete was placed on September 12, and was continued to the 1st of December, when it was stopped for the winter, with a total of 7,400 cubic yards in place.

The normal water level of the river was at elevation 278 and flood level at 285. In order to leave sufficient openings to carry off a heavy spring flood five sluices, 12 x 19 feet, 6 inches high, with a bottom elevation of 278, and a temporary spillway 178 feet long, at elevation 293.5, were provided. Over the sluices and at the island the concrete was brought to elevation 300, to form temporary bulkhead sections. In the sluices grooves were left to permit the lowering of stop-logs to regulate the flood for transportation purposes and to accumulate a storage for use upon completion.

In the fall of 1916 the construction of the upper and lower main channel coffer-dams were started. The crib work and sheeting were completed by December 1, and filled during the late fall and winter.

The upper coffer-dam consists of a crib 60 feet wide, compactly filled with rock, which, on the downstream face, was dumped so as to form a one-to-one slope from the top. The sheeting on the water face was vertical, and consisted of one row of 2-inch planking, with an outer sheeting of 1-inch lumber. A wide strip of heavy canvas was nailed to the bottom of the sheeting and allowed to rest on the river bed. A large quantity of toe filling was then deposited, which securely held it in place. This temporary dam was 630 feet long, contain 27,000 cubic yards of filling, and withstood a head of 43 feet. During the summer the water rose in the reservoir to elevation 298.6, or within a foot and a half of the top. The water thus stored, which amounted to nineteen billion cubic feet, is being used to regulate the flowing during the winter.



View of dam from eastern bank, east channel. Shows pipes carrying off water from No. 1 east channel temporary sluice.

The lower coffer was designed for a head of 28 feet. It was of the ordinary rock-filled crib type, having a base of 42 feet and stepped in to 14 feet at the top. It was 450 feet long, with a top elevation of 285.

The total leak from both coffer-dams was remarkably small. After the site was unwatered a 10-inch centrifugal pump, running at two-thirds capacity, handled the entire leak, which did not exceed 2,000 gallons per minute.

The work of preparing the foundation was continued all winter. Concreting was recommenced on the 18th of April and carried on continuously to December 8, when the dam was finally completed.

View of dam from eastern end of construction trestle.

Three one-yard mixers were used, one of which had its concrete deposited by a spouting system, while from the others the concrete run into side dump cars or buckets placed on small flat cars, which were hauled by horses along a trestle built clear of the downstream face of the dam. Two stiff-leg derricks, each mounted on two standard-gauge flat cars, travelling on trestles 36 feet apart, handled the concrete buckets. The concrete poured into the dump cars was deposited by means of chutes from the trestle, which was at elevation 294. During the months of July and August a maximum of 15,000 cubic yards were placed. Plums to the extent of 15½ per cent. were embedded in the concrete.

In the main channel of the river there are 10 sluices, having intake openings 12 x 7½ feet wide, and increased to 16 x 8½ feet on the down-stream face. They are lined with 3/8-inch steel and stiffened with 6 x 3½ x 3/8-in. angles, which also serve to hold them securely in the concrete. The tops of the sluices are at elevation 278. The water is regulated by steel gates 8 x 12½ feet high, which are made of 12-inch I-beams, covered with a 3/8-inch plate. They are of the sliding type, and bear against two 12-inch I's embedded in the concrete. To avoid rusting, the bearing is made of babbit sliding on bronze. The gates weigh four tons, and are connected by lifting arms to machinery situated on top of the dam and operated by hand-power.

Originally it was intended to have one 8-ft. log sluice, but it was later decided to add another one 16 ft. wide. The former can be adjusted to any height of water between elevations 295 and 325. This is accomplished by means of an 80-ft. steel trough, hinged at one end to the upper of two sliding steel gates, which can be raised or lowered by means of machinery. The lower end is carried on wheels working on a track embedded in a concrete block built clear of the downstream face of the dam, and is free to move in a horizontal direction.

The structural steel was furnished by the Phoenix Bridge and Ironworks, Ltd., and the hoisting machinery by the Jenckes Machine Company, of Sherbrooke.

Concrete block houses, with wood roofs covered by galvanized iron, and supported by steel trusses and columns, have been built over the log sluice and sluice gate sections. It is intended to heat the gate-house by electricity, supplied by the plant at La Loutre Rapids, which has been taken over by the commission.

The dam is 1,646 feet long and contains 72,290 cubic yards of masonry. For purposes of description it may be divided into three sections. The spillway has a length of 840 feet and a crest level of 325. Provision has been made to increase this to 328 by flash boards. The bulkhead and suiceway section make up the remainder, and have a top level of 335. The sluice section is 200 feet in length, and is located in the central portion of the main channel.

Throughout the dam rests on solid Gneis foundations, which are of a very tight character. A few seams were encountered near the surface, but did not penetrate to any great depth. The lowest elevation found was 238.5, which gives the dam a maximum height of 96½ feet. To withstand an assumed ice pressure of 50,000 pounds per lineal foot it was heavily reinforced on the water face with 1-inch steel bars 4 inches on centres. In the spillway section, 1½-inch dowel bars 9 feet long, and spaced 2 feet, c. to c., were anchored three feet in the rock.

Great interest has been aroused by this dam for the following reasons: (1) Its remote situation, involving great difficulties in transportation; (2) that it was heavily reinforced on its pressure face to withstand an assumed ice pressure of 50,000 pounds per lineal foot; and (3) the size of the reservoir which will be created. When full, it will contain 160,000,000,000 cubic feet of water, being about double that impounded by the Assouan Dam, in Egypt, which previously held the record.

The members of the commission who recommended and carried out the project are: The Hon. S. N. Parent, chairman; Mr. W. I. Bishop and the late Mr. Ernest Belanger, commissioners, and Mr. O. Lefebvre, chief engineer. Mr. J. B. D'Aeth was resident engineer for the commission, and was assisted by M. H. Massue.

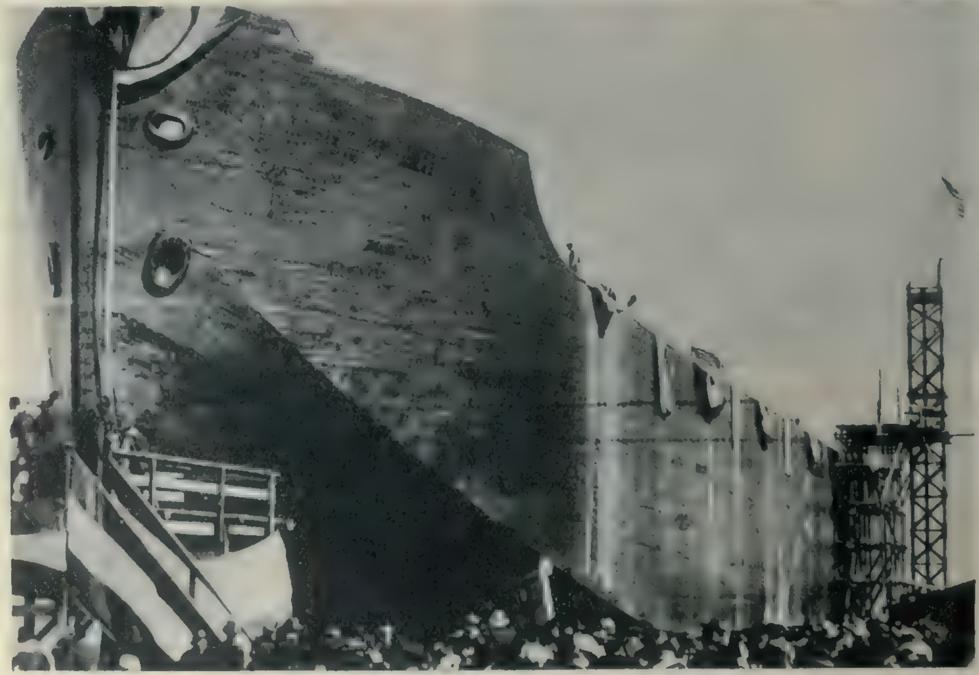
The chief members of the St. Maurice Construction Company, Ltd., are: Messrs. Julian C. Smith, of the Shawinigan Water and Power Company, president; C. E. Fraser, of Fraser, Brace & Co., managing director; J. J. McCarthy, general superintendent, and Charles Luscombe, resident engineer.

The "Faith" Demonstrates Concrete Shipbuilding Possibilities

LAST August the San Francisco Shipbuilding Company began the construction at Redwood, California, of the ways of a reinforced concrete ship, comparable in size to the modern steel freighters. This vessels is said to be the pioneer of 54 similar ships to be built within 18 months. Its displacement is 7,900 tons, its burden 5,500 tons, and it will be equipped with engines having 1,750 h.p. The length is 336 ft., the depth 31 ft., and the beam 45 ft.

It had been the intention of the builders to load the vessel with ballast and make an experimental sea trip, but this plan has been abandoned because the launching itself is now regarded as constituting a sufficient test of strength. The vessel was launched sideways, on March 14, about six weeks after the first concrete was poured. She drew less than 9 ft., and showed no sign of cracks, although the hull had been subjected to very severe strains.

It is perhaps not saying too much to predict a complete revolution in shipbuilding if the "Faith," this pioneer large concrete ship, shall prove seaworthy and durable. Few engineers skilled in reinforced concrete design have ever doubted the possibility of making a successful concrete vessel of great size, so far as mere strength is concerned. Nor have many engineers questioned the economy in first cost. The main doubt has been as to the durability of the reinforcing steel under sea water. This doubt still remains, but we entertain no doubt that the steel can be protected by waterproofing the concrete.



Reinforced concrete ship "Faith" prior to launching.

Concrete Highway Bridge Design in Ontario

Highways Department Prepares Typical Plans and Specifications to Insure Safe Structures

OWING to the non-uniformity of bridge designs and the unwarranted number of failures, an amendment to the Ontario Municipal Act was passed in 1916 making it compulsory to submit plans of any bridge exceeding 20 ft. in length to the Department of Highways for the approval of their engineers. The Municipal Amendment Act, Ontario (6 George V., Chap. 39), provides as follows:

> 459. (1) Every iron, steel, concrete or stone bridge constructed by the corporation of a county, and every such bridge exceeding twenty feet (20) clear span constructed by the corporation of a township shall be designed and built in accordance with general specifications approved by the Department of Public Highways.
>
> (2) Plans in duplicate for any such bridges may be submitted by the council of any county or township to the Department of Public Highways, and if they are found to be in accordance with such approved general specifications the certificate of the department shall be attached, and one of such plans shall be returned to the clerk of such county or township.

The intention of the legislation is primarily to standardize the strength of the structures—but not particularly the design—since any method, such as beam, truss, arch, or suspension, may be employed so long as the stress can be statically figured. Prior to the passage of the amendment many municipalities would call for competitive designs, along with prices for material, from the various steel companies and from concerns interested in the sale of some particular steel bar for reinforcing. These designs were, in isolated cases, the work of some inexperienced and incapable draftsman, and occasionally companies who were commercializing the profession were prone to "skimp" the work in order to secure the sale of their material. The members of a municipal council, not being engineers, could hardly be expected to check up the figures, and generally made the mistake of accepting the lowest tender. without any regard to the strength of the structure. It was supposed that the plans were prepared by competent engineers who knew their business and who were compelled to abide by certain regulations governing the design. The investigations of the department brought out many incidents, such as the failure to place lateral braces on the trusses of a steel bridge to provide for any side shear, and the using of too light a section to take care of the load. Other failures were traced directly to the lack of proper supervision. In order to facilitate the operation of the act the department designed typical plans and specifications along approved lines. These plans and specifications are for the guidance of engineers in bridge design, and typify the character of design approved of by the department of highways.

Specifications for Concrete Bridges

Several tables and interesting sections from the general specifications of concrete highway bridges follow:

> The general type of concrete bridge shall preferably be as follows, but it is understood that the limiting lengths are not absolute, and may be varied as occasion permits:
>
> (1) A concrete arch, or concrete abutments with slab covering for spans up to 18 feet.
>
> (2) A concrete arch, or concrete beam bridge for spans from 18 feet to 40 feet.
>
> (3) A concrete arch for spans exceeding 40 feet in length.
>
> (4) All parts of the concrete structure shall be proportioned so as not to exceed the following unit stresses in pounds per square inch for stone or gravel concrete:

Extreme fibres of beams and slabs for bending	650
Columns whose length does not exceed 15 times the least width	500
Hooped columns, whose length does not exceed 15 times the least width	650

80 ft. arch span, 16 ft. roadway, 2 sidewalks 4 ft. 6 in.

Shearing stress in concrete	60
Bond between plain steel and concrete	60
Bond between deformed steel and concrete	100
Tension in structural steel	16,000
Hard steel, tension	20,000

Reinforced concrete beams and slabs will be designed on the assumption that compressive stresses vary directly as the distance from the neutral axis. No allowance will be made for concrete in tension. The ratio of moduli of elasticity for steel and concrete will be assumed as 15. All calculations will be based on concrete having a crushing strength of 2,000 pounds per square inch in 28 days.

Classification

Bridges will be classified according to loading as follows:

Class A—Bridges suitable for main county roads.

Class B—Bridges suitable for light country traffic.

Class C—Bridges suitable for heavy and concentrated traffic.

	Uniform live load. Lbs. per sq. ft.	Concentrated live load.	Floor load. Pounds.
Class A	100	15 tons	3,000
Class B	100	10 "	3,000
Class C	135	20 "	4,000

Proportions of Gravel, Sand, and Cement

The proportions of materials to be used in mixing "fine" concrete shall be by measure, loose, and, unless otherwise directed by the engineer, shall be as follows:

Gravel Concrete

(a) Abutments, piers, and wing walls: One part of cement to six parts of gravel.

(b) Arches from the springing line, floor slabs, beams, and columns: One part cement to five parts gravel.

(c) Floor slabs used as pavements, parapet walls, and handrails: One part cement to four parts gravel.

Broken Stone Concrete

(d) Abutments, piers, and wing walls: One part cement, two parts sand, and five parts broken stone.

(e) Arches from the springing line, floor slabs, beams, and columns: One part cement, two parts sand, and four parts broken stone.

(f) Floor slabs used as pavements, parapet walls, and handrails: One part cement, one and one-half parts sand, and three parts broken stone.

The proportioning of materials may be varied by the engineer from the foregoing, on the basis of voids in the aggregates, to secure a compact mixture, but the amount of cement is also to be determined by the strength of mortar required. In no case is less cement to be used than is needed to fill the voids in the sand or fine aggregates when dry; but the interstices of the coarse aggregates should be measured and at least sufficient mortar used to fill the voids and give a 10 per cent. surplus.

Bonding Concrete

Where mass concrete work is interrupted before its completion or at the close of the day, a sufficient number of well wetted one-man stone shall be placed so as to project above the concrete surface to ensure bond with succeeding concrete work. Before the work of depositing concrete is resumed this surface shall be thoroughly wetted and cleansed of foreign material and laitance. A mortar consisting of one part cement to two parts sand shall then be deposited on the wetted surface to a depth of about one-half inch when the work of placing concrete shall be resumed. Where thin sections of concrete work are interrupted, or at the close of the day, no concrete shall again be deposited until the surface has been roughened, thoroughly wetted and cleansed of foreign material, and a mortar of one part cement to two parts of sand spread over the wetted surface to a depth of about one-half inch.

Operating Problems of Imhoff Tanks

MR. GEORGE W. FULLER, consulting engineer, New York, recently presented a paper before the New Jersey Sewage Works Association, reviewing in a comprehensive way the operating problems of Imhoff tanks. His remarks have a special reference to smaller plants. Mr. Fuller's summary of his observations is as follows:

1. Small plants of the Imhoff tank type, receiving the flow of separate sewers, are frequently more difficult to operate than larger ones receiving the flow of combined sewers, because the relatively large suspended particles reaching the digestion chamber respond for long periods at a time to flotation rather than sedimentation.

Keep Solids in Their Place

2. Careful attention to the prevention or frequent removal of stranded solids in the collecting sewers, inlet channels of the tanks and on the bottom and sides of the upper or sedimentation compartment; to the uniform distribution of solids in the several sections of the tanks; to the frequent removal of grease and scum from the surface of the sedimentation compartment, is helpful and important. But it will not necessarily eliminate abnormally long periods for the "ripening process," following which well-digested sludge is obtained without objectionable odors.

3. Normal digestion of sludge to an inodorous humus mass, with a fairly uniform liberation of the resulting gases caused by the inevitable splitting apart of carbon, hydrogen, nitrogen, and sulphur atoms contained in the complex molecules of suspended organic substances, is seemingly effected by enzymes or liquid ferments excreted by certain kinds of bacteria.

4. When tanks are new, and when for any unforeseen reason old tanks lose their efficient digestive functions, ordinary bacterial decomposition predominates over enzyme digestion, with attending possibilities as to odor complications from incompletely digested sludge, or from the release of intermediate decomposition products, particularly those of a sulphurous nature, or from both. Tanks in this condition are said to be undergoing the "ripening process," which fortunately does not seem to be necessary, as a rule, other than with new tanks, although there have been some exceptions to this general experience.

5. There is no way of telling in advance how long a period of ripening may be necessary for a given tank, as different results come in different units of the same plant. Some kinds of bacteria grow prolifically and preclude the development of suitable enzyme-producing bacteria as a result of "bacterial antagonism" caused by the excretion of waste products. This may be as capricious a matter as the occurrence of weeds in a field or of algae in an unpolluted lake. "Seeding" a tank with ripened sludge from another tank has not proved to be as reliably helpful as was expected.

6. Objectionable odors may arise in varying degree, depending upon local factors, but largely upon the lack of opportunities for absorption of odoriferous compounds by surrounding water and upon accumulation of gas which may be released intermittently in masses or "whiffs" so to speak, following barometric changes and interruptions in free venting.

7. The secret of success in operating Imhoff tanks is to retain in them relatively small quantities of decomposing solids and to do all that is practicable to secure a proper balance between enzyme liquefaction

and bacterial decomposition with a predominance, of course, of the former. This explains why tanks receiving only relatively small quantities of sewage when new do so well in digesting sludge. It raises the issue of sludge storage capacities.

8. Quiescent masses of sewage solids, either scum or bottom sludge, are scarcely capable of satisfactory decomposition as antagonistic products of bacterial life seem to have a decidedly retarding effect.

9. Lime will lessen excessive acid formation in sludge, but it will scarcely cause the establishment of the right kinds of bacteria for enzyme production. In fact, it may result in increasing abnormalities.

Mechanical Devices for Stirring Sludge

10. Agitation by pressure water jets or paddling may be of aid. In Europe mechanical stirring devices have been proposed. The benefit of stirring and mixing seems to lessen with increasing volumes of sewage solids in a tank, due to a loss of efficiency of the stirring arrangements. This step, if carried too far, may also remove entrained gas to such an extent that non-gaseous, sticky, foul-smelling sludge is obtained under circumstances requiring its removal and burial or treatment with a deodorant.

11. Acid foaming at gas vents sometimes becomes very bothersome where the gas vents contain large quantities of floating scum undergoing bacterial decomposition in the absence of adequate enzyme digestion.

12. Slot trapping by gas and gas-lifted solids, which fill the space above the slots, frequently accompanies foaming, and may carry decomposing solids into the settling compartment from the sludge chamber below, as well as by overflowing from the top of the gas vents.

13. Overflowing from foaming cannot be stopped in some tanks, even if the gas vents be extended 5 or 10 feet or more above the flow line. High freeboard, housing with pressure water, stirring and liming, all tend to help, but collectively may not be a prompt cure. Aggravated cases are not cured by putting a tank out of service for months. In some tanks sludge removal from the bottom affords a remedy, but this is not available for tanks containing most of the solid matter in a floating condition. The surest remedy in such cases is to remove the great bulk of floating solids from the gas vents until only small quantities remain. Obviously such removal must be done in a way to minimize offence.

14. Scum storage for floating solids above the elevation of the slot should be provided for much more liberally than hitherto for small plants, expected to receive during the first year of their operation a substantial proportion of their normal daily quantity of sewage.

15. Scum removal may be necessary in some plants even where there is fairly liberal allowance for scum storage. It depends partly on intensity of gasification, partly on the adhesiveness of the scum (gas-retaining capacity), and partly on the success attending efforts to make portions of the sludge remain in the lower part of the digestion chamber. In aggravated cases scum removal is imperative, but it should be carried out with caution.

Screens for Scum Prevention

16. Scum prevention comes about in some degree through comminution incident to pumping, and may be further aided through the use of screens. Sometimes screening is provided in front of pumps. At Rochester, N.Y., the flow of a gravity outfall sewer now passes through a fine screen on its way to Imhoff tanks. Similar provision has been recommended at Plainfield, N.J. Such a step adds materially to the cost of sewage treatment, but evidence at Reading, Philadelphia, and Chicago shows that it reduces scum formation to a substantial degree. Its advisability for a given project depends upon whether the need is commensurate with the cost

17. Normal Imhoff sludge is dark-colored, practically inodorous, and shows a curdled appearance when it flows in a thin layer down the side of a container. Much difficulty with odor has followed the withdrawal of undigested sludge to a drying bed, and an operator should carefully note the condition of the sludge before and during its removal. But difficulty has also resulted from retaining sludge for a year or more in a tank under conditions where suitable enzyme digestion does not prevail. Such sticky grey or yellowish sludge may be foul-smelling, but it is wisest in some cases to remove it, with greatest care taken to prevent nuisance from odors. Complete digestion is not always attainable.

18. Sludge storage capacities are provided more liberally than formerly and with good reason. It is not unusual to find extremely thin or dilute sludge in a digestion chamber, and this high water content is quite a factor in causing a demand for larger sludge chambers. Another item is the relatively long period of cold weather during which little or no sludge can be removed. This applies particularly to Northern plants put in service during the late summer or fall.

19. Sludge beds should be at least double the areas recommended by Dr. Imhoff, due to the frequency and intensity of rainfall in our Northern states—unless covers of the greenhouse type should be provided.

20. It is well to empty idle tanks and conduits; otherwise offensive odors may ensue.

Vancouver Harbor Board and City Disagree

The Harbor Commission of Vancouver and the City Council have a complex question to settle, which, in short, is as follows: The Board of Harbor Commissioners, with the aid of the Dominion Government, has created an excellent industrial site in the bed of False Creek, Vancouver, which is in the form of an island reclaimed from the mud flats. The work has been completed, and the harbor commissioners have received applications for sites from all over the continent. The question to be settled is this: As the island is within the city of Vancouver, should the property not bear city taxes, as in the case of other sites? The harbor commissioners maintain that, as the city did not give any aid or assist in the financing of the work, that they have no interest in same, and should not make an attempt to tax the property. Commissioner Sam McClay points out that, while the city had given no encouragement to the undertaking, it will indirectly benefit very largely through the establishment of the manufacturing plants on the island. The only connection the city has with the island is the city water that passes through the harbor board mains. An alderman has suggested that if the board does not pay the taxes the water supply be cut off. To this the board replies by saying that they will drill an artesian well, as was done by the Seattle port commission.

Salt mixed with sand or gravel has been found to be effective in preventing slipperiness of pavements at bridge approaches.

L'Academie De La Salle, Three Rivers, P.Q.

ONE of the largest schools in the Province of Quebec is now completed. This is the Académie de La Salle, an annex to the old St. Ursule School, which is one of the historic institutions of Three Rivers. Form the standpoint of accommodation this school is unsurpassed in the district, and, although it is a common brick building, cut stone has been distributed in such a manner as to give it an imposing appearance. The site is at the corner of La Violette Avenue and St. Pierre Street, in the heart of the city. The building is of an "L" shape, 250 ft. on the main frontage by 50 ft. in depth, with the wing 50 ft. by 40 ft. It is three storeys high, and has a basement under the whole structure. It contains fourteen class-rooms, with a capacity for seating 20 to 40 pupils. The total accommodation is for 500 pupils.

The basement contains: Refectories for teachers and pupils, modern kitchens, a gymnasium hall with concrete flooring, two shower-bath rooms, consisting of a series of 20 small marble compartments 6 ft. high, with terrazzo flooring; toilet accommodation, with marble compartments and tile flooring; a furnace room, containing five Brunelle hot water furnaces, No. H. Each furnace, it is estimated, will burn 50 tons of coal per season and heat approximately 2,000 gallons of water. Behind the furnace lies a horizontal 1,000-gallon water tank, heated with two small special furnaces. There is also a pumping room, its equipment consisting of 2-inch centrifugal pump directly connected to a 5 h,p. electric motor, and a 3-inch centrifugal pump connected to a 7 h.p. electric motor. The capacity of the two pumps is 6,000 cubic feet of water per minute, and they are used in connection with the heating system to increase the circulation of the water. They were supplied by the Buffalo Pump Company, of Buffalo, N.Y., and the electric motors by the Lincoln Electric Company of Canada, Toronto. A dynamo supplies the electricity to a No. 400 Tuec stationary vacuum cleaner, supplied by the United Electric Company, of Toronto, and to 30 small 0.5 h.p. electric motors distributed in the different ventilatiing compartments througout the school.

The ground floor contains a reception hall, a museum of natural history, a commercial library with accommodation for 50 pupils, seven class-rooms, and a banking room completely furnished with wooden grilling and representing the installation of one trust and three banking houses. About 60 pupils can work on the exchange at the same time. The second floor has two study halls, seating from 120 to 130 pupils, modernly equipped, a complete physics and chemistry laboratory, the outfit for which was furnished by Messrs. Knot & Co. of Boston, Mass., an infirmary, a music hall, and seven class-rooms. The third floor has two large dormitories and lavatory equipment. The wing is reserved for the professors, 30 in number; this annex is built with a fire-wall extending to the roof.

In construction the building has a concrete foundation up to the ground level, where it is finished in cut stone, the plinth being of limestone. Limestone is also used for the main entrance steps, the side portal, the corners, sills, and lintels. The cornice is in wood, finished with white paint. The building required 980,000 brick, 140,000 ft. B.M. rough lumber, 60,000 ft. B.M. 7/8-in. birch flooring, 1,700 lineal yards of burlap, and 12,975 square yards of selanite for the walls. The greyish marble used in the washrooms, etc., was furnished by Messrs. Hamon & Hess, Montreal, P.Q., the cost of whose contract was $10,000. The plumbing, heating, and ventilation is very modern.

Mr. U. Asselin, architect, of Three Rivers, prepared the plans for the school. The ventilation was designed by the Canadian Domestic Engineering Company, Montreal. The general contractor was Mr. Anselme Dube, of Three Rivers, and sub-contracts were awarded as follows: Plumbing, Napoleon Deschenes, Three Rivers; masonry, M. Durochers, Three Rivers; furniture, Messrs. Alphonse Laurin & Cie, Three Rivers.

Use Drag to Maintain Clay and Gravel Roads

May be Employed to Great Advantage in the Spring— The Experiences of Two Ontario Good Roads Men

VERY effective work may be done on earth and gravel roads in the spring of the year by dragging, thus materially lessening the cost of maintenance during the summer months. No definite rules can be formulated setting forth where one should use a scraper, harrow, or road drag. This is purely a matter of good judgment on the part of the road foreman, and depends entirely on the conditions met with in his particular locality. Roads of the same kind require different treatment in different sections. This is largely accounted for by the difference in the subsoil and drainage, and largely by the character of work that has been done on the road in the past. Road superintendents are universally of the opinion that it is often very hard to construct a good road and that it takes very little neglect to make it practically unfit for travel. Conscientious and proper use of the road drag is a very important factor in the upkeep of roads.

It is of interest to road-makers generally to know when a log or iron drag may be used to advantage. A road scraper is essentially a road construction machine, and is used for shaping the road to its proper profile; the road drag is an appliance for maintenance, and is used to plane off the tops of the ridges and rough places, drawing the material forward and sideways to fill up the hollows and ruts. There are two main types of drag, viz., the steel drag and the split-log drag. The split-log drag is the more widely used because it is very easy to construct. The Department of Highways, in the appendix to the annual report on township road improvement for 1918, on pages 6 and 7, describe the method of constructing a two-blade wood drag. At the recent road conference held at Toronto the subject of road drags was discussed at length (see March 6 and 13 issues of the Contract Record). A light drag is preferred. By this is meant that one should use a drag that is of sufficient weight to smooth the road, but it is not intended that one should grade with the drag. The folly of using a drag weighing six or seven hundred pounds when one weighing two or three hundred might accomplish the work was pointed out at the conference for road superintendents.

We are publishing letters from Mr. Charles Talbot, engineer and road superintendent of Middlesex County, Ont., and Mr. Peter Robertson, road superintendent of the County of Lincoln, Ont. These men are both to be congratulated on good work they have accomplished for their counties, and have had wide and varied experience in making and maintaining earth roads.

* * *

London, Ont.

Editor Contract Record:

Re spring road maintenance: very little, if any, effective work can be done with a road drag, scraper, or grader until the frost is out, or nearly out, of the ground. Men in charge of the roads can spend money to good advantage in the early spring by removing ice and snow from the roads and ditches so as to permit the water to flow readily to outlets and in opening obstructed culverts and underdrains.

Before the drag can be used with effect on a road the road grade must have a crown sufficient to permit the water to flow to the side ditches after scraping. In fact, unless the road was properly crowned last fall there is little use in moving the drag on it. If the road is crowned, the drag should be used as soon as roadbed begins to dry, and as often thereafter as necessary to keep the road smooth and the depressions filled. If the season is wet the work is very discouraging, and unless the man in charge is backed up by those in authority, he will give it up as a bad job. Under favorable conditions, however, good results will follow the careful and persistent efforts of an enthusiastic roadman.

Last spring, in Western Ontario, the weather was very unfavorable for this work. Middlesex County spent many hundred dollars in operating drags and scrapers that were not effective, for immediately after each scraping there developed a wet period of one or two days. From these scrapings no apparent improvement resulted, and only later work was effective. This experience is no excuse for losing faith in the effectiveness of road dragging, which is, in my opinion, the only plan for the effective and economic maintenance of the earth road and the lighter form of gravel roads. Excellent results will be produced if the work is in charge of a man who believes in the necessity for the work, understands how and when it should be done, and does it when and as he knows he should. The kind of machine used is not important, but the operator must believe he has one that will produce results. I have seen men become completely out of patience with what they termed "new-fangled machines" and throw them aside for their old standby, the "log drag," and, as a matter of fact, no better drag is required, provided the grade is right.

Yours very truly,
Charles Talbot,
Engineer, County of Middlesex.

* * *

Beamsville, Ont.

Editor Contract Record:

I find, after I have clay roads properly graded, the best and only way to keep them fit for traffic is by using the split-log drag or the steel two-blade drag. The drag must be used at the proper time to get the best results. I have had the best results and kept my road in the more perfect condition for traffic by using the drag just when road was dry enough that the clay would pulverize, so that the ruts and depressions would be filled. Then we have tried what is called puddling, by hauling the split-log drag backwards, when roads are in a muddy condition, but found that the roads would get rutted before they dried and were solid, and would have to be dragged over.

We have many types of drags in our county—the split-log and steel drag with two blades and the three-bladed drag made of two-inch plank, each blade directly behind the front blade and hauled by a chain on an angle. Another three-blade drag is made with blades staggered and hauled straight. We find that the last two drags do better work in filling ruts and depressions with least cost.

Peter Robertson,
County Road Superintendent.

Possibilities of Lessening Fuel Consumption by the Adoption of Electrical Heating

*By P. H. Mitchell

The use of electricity in heating to lessen the fuel consumption can have very little material effect on the situation at the present moment, due mainly to the general economic limitation of available electric power and to the high cost of heating produced electrically as compared with the cost of heating by means of the common fuels.

In the future, and probably in the near future, electricity, from its possible cheapness, its possible sufficient available supply and, further, in some districts from its necessity. due to insufficient supply of combustible fuels, may assume a very important role in the heating field. It is only by electricity developed from water-power that the sufficiently low cost may be attained to make electrical heating feasible.

Canada is blessed with an abundance of water-power and, in some districts, with ample coal deposits. Nova Scotia coal is used in Nova Scotia, New Brunswick, Prince Edward Island, and Quebec; Nicola Valley and Vancouver Island coals are used in British Columbia; Crow's Nest, Lethbridge, and Edmonton coals are used in Alberta and portions of Saskatchewan and Manitoba; Ontario, practically all of Manitoba, and a small part of Quebec are dependent on United States soft coal, and United States anthracite is used over a slightly larger area.

Water-Powers Serve Districts Lacking Coal

In examining the map of Canada, having in mind the distribution of coal areas and water-power areas. it is apparent that the districts not readily served with native coal are the districts most abundantly served with water-powers. From Montreal westward to Manitoba, in the districts supplied by United States coal, the water-powers are destined to be developed to their maximums to serve the industries and utilities of the future.

It does not need much imagination to look forward, say, fifty years, a period which may be within the lifetime of a large number of us. What will be the fuel situation then? Will coal. as normally at present, be available in generous supply? Will the peat and oil sources be meeting any lack of coal? Statistics do not show a promise of this, and in the meantime, if this is "Canada's century," what is the prospect of population? An increase to 25,000,000 people by 1968, I am sure, is a figure well within the expectation of all. and Central Canada's share of this may be 15,000,000, all dwelling in the area now dependent on imported fuel.

Further, our fuel situation is so closely meshed with that of the United States that we must appreciate their viewpoint. Are two hundred millions of population in the United States in 1968 beyond a conservative estimate? Many think not, and with a fuel consumption advancing out of all proportion to increase of population, an economic limit of fuels is in sight. The prospect may result in a most drastic administration of fuels, applying these to heating purposes only, leaving to hydro-electric power all mechanical, railroad, and metallurgical operations in the endeavor to conserve the diminishing supply, and even then such a radical curtailment will only push forward the day when the substitution for fuels must be made.

The fuels of to-day are wood, coal, natural gas, peat, and oil. Of these wood and natural gas are limited for many reasons, and peat is a fuel only by extreme necessity. and as yet is not a commercially accepted probability.

It may be that some genius will conserve and redirect the vast heat transfers of nature to serve mankind, but to-day, in addition to the combustible fuels, we can only add electricity to complete the list of sources of artificial heat.

In all discussion of electrical heating there is one outstanding basis, and that is the thermal value of electricity. One kilowatt hour of electrical energy is equal to 3,413 British thermal units, or one kilowatt hour of electrical energy is capable of raising the temperature of 3,413 pounds of water one degree Fahrenheit. This heating value may be compared with that of other heating sources, and we find that, fundamentally, the ordinary heating mediums, at existing prices, are appreciably cheaper.

For instance, in the comparison of anthracite coal. bituminous coal, peat, oil fuel, and electricity we find:

Comparative B.T.U.'s for 1 Cent

Anthracite coal, in a well-built and well-regulated domestic furnace, is capable of being burned at about 55 per cent. efficiency. A good anthracite contains 13,000 B.t.u.'s per pound. At $8 per ton, 1 cent will purchase 18,000 British thermal units of heat.

Bituminous coal, when burned in a first-class mechanically-stoked boiler installation and distributed for heating purposes, is capable of about 60 per cent. overall efficiency. A good bituminous coal contains 14,000 B.t.u.'s per pound. At $3.50 per ton 1 cent will purchase 48,000 British thermal units of heat.

Peat. in briquet form, with low moisture content, in a properly-arranged furnace, should produce heat available for heating 60 per cent. efficiency on, say, 7,000 B.t.u.'s net available. The industry should be able to approach $4 per ton, so that 1 cent would purchase 21,000 British thermal units of heat.

Fuel oil may burn with 65 per cent. overall efficiency. One pound of the oil obtainable in the local market contains about 18,000 B.t.u.'s. At 7 cents per imperial gallon 1 cent will purchase 15,500 British thermal units of heat.

Electricity, when supplied to well-designed heating equipment, is capable of utilization at 100 per cent. efficiency. One kilowatt hour equals 3,413 B.t.u.'s. With electricity at 1 cent per kilowatt hour 1 cent will purchase 3,413 British thermal units of heat

Or, with electricity purchased at power rates in Ottawa or Toronto. which would average throughout twelve months at 8/10 of 1 cent per kilowatt hour, 1 cent will purchase 4,240 British thermal units of heat.

To-day fuels are more expensive than shown by the above prices, which indicate conditions at more like normal times or what we may expect after the war is over. For instance, in Toronto to-day anthracite will cost $10 per ton, bituminous coal $7.50 per ton, and fuel oil 14 cents per imperial gallon. The cost of electrical power has, unlike almost every other nameable commodity, had a downward tendency, and to-day is generally appreciably lower than before the war.

To recapitulate so that comparison of heating costs may be facilitated, and also showing fuel costs as at present, we find:

One cent will purchase of useable heat:

	B.t.u.'s.
From anthracite at $8 per ton	18,000
From anthracite at $10 per ton	14,300

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*Consulting Engineer, Toronto, Ont. before Professional Meeting, C.S.C.E.

From bituminous coal at $3.50 per ton	48,000
From bituminous coal at $7 per ton	24,000
From peat at $4 per ton	21,000
From fuel oil at 0.07 per gallon	15,500
From fuel oil at .14 per gallon	7,750
From electricity at 0.01 per kilowatt hour	3,413
From electricity at 0.008 per kilowatt hour	4,240

It must be born in mind that these costs and efficiencies are based on producing heated rooms in buildings, such as dwellings, and that electricity is shown used at 100 per cent. efficiency, assuming it directly applied to the room to be heated, and not affected by the unapplied waste of the other heating systems in chimney, boiler, and transmission losses.

Bituminous coal can only be used in heating plants of some magnitude, and is not suitable for dwellings except by distribution from a central steam plant. Heating by anthracite coal is the source to which electricity is to be compared.

Convenience of Electricity Offsets Extra Capital Charges

It is obvious that the cost of fuel is not the only factor in the cost of heating, but that the cost of heating equipment, attention to fires, disposal of ashes, and even. further, the extra cost of basement for heating equipment, fuel storage, and even the more or less chimneys required, are appreciable items, while fire insurance also plays a part. To go fully into all these items is quite beyond the scope of this paper, but I would propose a well-based assumption that, while the equipment for electrical heating for houses is more expensive than, say, hot air equipment, the greater annual charges against capital costs and for repairs, etc., are more than offset by the greater convenience in the handling of electricity as a heating source rather than coal.

Electricity, to seriously enter the heating field, must. instead of costing 1 cent per kilowatt hour or 1 cent for 3,413 British thermal units, approach 1/5 cent per kilowatt hour, or 1 cent for 17,065 kilowatt hours when it can economically compare with heating by anthracite coal at a fuel cost of 1 cent for 18,000 B.t.u.'s.

Let us consider an electrical heating load in detail. Assume, first, that a house, two storeys and basement, with 600 square feet area on the ground, requires as its maximum here in Toronto a demand of 12 kilowatts. We would find that the use of this throughout the year would be approximately as follows, the load factor being on the maximum demand of the year:

For two months, 12 kilowatts on average 80 per cent. load factor; for two months 12 kilowatts on average 65 per cent. load factor; for two months 12 kilowatts on average 45 per cent. load factor; for two months 12 kilowatts on average 20 per cent. load factor; for four months, 12 kilowatts on average 0 per cent. load factor.

This means a load factor of 35 per cent. over the year, or for eight months, including summer, a load factor of 16.25 per cent. The general use of electricity for heating will involve a scale of millions of horse-power. With the present heating appliances available we cannot expect plants to be built and electricity to be generated for heating purposes only, so we must consider whether we can expect the development of an elastic commercial load of such magnitude that over twelve months of the year a 65 per cent. load factor, the complement of the 35 per cent. heating load factor, can be obtained so as to provide for 24 hours per day and 365 days in the year a 100 per cent. load factor load.

Industrial Demands May Complement Heating Load

It will possibly suffice to answer this by indicating one prospective industry, the electric power demand, of which alone may readily keep pace with the future use of electric heating—that is, the manufacture of nitrogen products for fertilizers. With the depletion of natural fertility artificial fertilizers will be demanded throughout Canada. Briefly, one horse-power year will produce fertilizer for 100 acres of cultivated wheat land, so that 1,000,000 horse-power, on the 65 per cent. load factor available. would produce fertilizer for 100,000 square miles. There is no question of our complete dependence on manufactured nitrates in the not far distant future and on a scale which involves millions of horse-power.

Or it may be that the demand for electrical heating will be such that this load will be of primary importance itself, and the future form of heating equipment by which electrical heating will be accomplished may be, of necessity, radically different from the present-day devices to meet the requirements. Economical heating apparatus will undoubtedly be of the heat-storing type, so as to take advantage of the power available on the off-peak periods. These may use masses of high specific heat materials, or even steam reservoirs, in which to store and liberate heat over a 24-hour cycle; and, further, the 24-hour use of electricity may be arranged to meet only the average conditions, the surplus available during below-average periods being used for the manufacture of fuels, such as hydrogen, to be stored for use in the above average periods. thus providing a continuous electrical heating load over a yearly cycle.

The combination of the maximum developments of many of our great power sites should, when the non-heating load period has been organized to use power along other lines. or when a continuous heating load on a yearly cycle is established, readily make power available for electric heating purposes at an equivalent cost of less than $12 per horse-power year delivered in districts even remote from the generating source. Then the rate for heating purposes would be below .2 cents per kilowatt hour, or 1 cent would purchase over 18,000 British thermal units of applied heat. Electricity then, if available in the necessary quantities, would readily become the foremost source of artificial heat.

The use of electricity for many of the other domestic uses for heat, such as for cooking, water heating, etc., is well established, and forms no mean portion of the present electrical loads.

Power Development May Exceed Present Estimates

Now, when we speak of millions of horse-power and our possible future dependence on a general use of electrical heating in Central Canada are we justified in anticipating that such enormous quantities of power will be available

The latest comprehensive compilation of water-power resources in Canada gives a total of about 18,000,000 horse-power available in the 2.000,000 of the 3.729,700 square miles of Canada's area which may be expected to be fairly thickly populated within the next few decades. It is stipulated for this figure that it is "inclusive in the case of Niagara Falls. Fort Frances, and the St. Mary's River at Sault Ste. Marie, of only the development permitted by international treaties. and, further, does not contemplate the full possibilities of storage for the improvement of capacities." The effect of such a restriction in the compilation of the totals of the water-power resources may be indicated by the available power on the Canadian side at Niagara Falls when developed to a maximum, being over 2,000,000 horse-power, while less than 500,000 horse-power is permitted by agreements, the restrictions being practically dictated by the desire to retain the scenic beauty of the falls. Again, practically all the water-powers of Ontario on the Great Lakes and James Bay sides of the height of land are quite dependent on storage, so that, instead of some 5,500,000 horse-power being listed as Ontario's portion. 12,000.000 here alone would more likely represent the possible development that the future may see. and it may be that, instead of 17,830,000 horse-power in the southerly half of Canada, 35,000,000 horse-power may be produced.

The present enormous use of electric power really had its inception 25 years ago, when electric power was first transmitted from Niagara Falls, N.Y,, to Buffalo, while in Canada, in the last 12 years. the demand has jumped from about zero to the astounding figures of the present. To-day, while there are 409,000 horse-power generated at Niagara Falls, there is a serious power shortage, and the power-users are feverishly awaiting further developments of hundreds of thousands of horse-power at this source. If since 1905, and more particularly just within the last few years, the power demand has grown so rapidly, what will fifty years from now see? Possibly it will then be a scarcity of sites to develop. and all may be interconnected into a vast network of transmission and distributing lines, all the sources combining to obtain the maximum of energy from the widely-distributed water-falls.

Eectric Heating Feasible at $12 Per H.P.

In conclusion, I would briefly summarize as follows:

1. Electric heating is not a present economic possibility, due to high cost and lack of available power.

2. Electric power rates would have to be one-quarter of the present rates for electric heating to compete with heating by anthracite coal.

3. Many millions of horse-power would be required to meet even present requirements. For example, I would estimate a demand of 2,000,000 horse-power to heat Toronto's dwellings and other buildings, or 4 horse-power per person of population.

4. When millions of horse-power in Canada are developed and, say, delivered, $12 power is attained, a large electric heating load may be established. This, of course, does not mean that every portion of the country could be served, but areas representing the great bulk of the population would be in the zones of distribution from such powers, and it might thus be possible to greatly substitute for coal and other fuels.

5. It may be that the economic future of our fuel and water-power resources will demand that in their administration fuels will be reserved for heating purposes and that the hydro-electric power available will be substituted to the maximum for all mechanical, railroad, and metallurgical operations.

6. By the use of devices for heat storing and fuel manufacturing, in combined or separate installations, so as to use throughout the yearly cycle a continuous heating load of 100 per cent. load factor, but of average rather than of peak demand, electric heating might be given a positively economic status, or, further the development of loads in millions of horse-power equalling in demand the electric power required for heating, yet elastic enough in its use to adapt to the low load periods of heating, may again suffice to make electrical heating of economic importance.

Discussion on Electric Heating

By H. G. Acres*

The four papers we have just heard cover such a vast field and furnish such limitless opportunities for discussion and conjucture that it is impossible to touch on more than one or two of the many points which are worth enlarging upon. In the first place I wish to consider, briefly, a matter alluded to by Mr. Challies and dealt with more at length by Mr. Mitchell; namely, house heating by electricity. Mr. Mitchell has very ably elucidated some points with reference to the feasibility of heating buildings, which perhaps are not generally appreciated, and it might be interesting to enlarge upon some of his conclusions with special reference to the problem of heating the city of Toronto with Niagara power.

First, as to cost—What fundamental condition accounts for the fact that a house in Toronto can be more cheaply heated by means of Pennsylvania coal than by Niagara power, supplied at actual cost? To work this out let us first take one kw. of potential heat from the falling waters of Niagara. Under peak load conditions, there will be 85 per cent. of this unit of heat left when it has passed through the turbine; 80 per cent. when it has passed through the generator; 76 per cent. when it has passed through the step-up transformer; possibly not more than 66 per cent. when it has passed over the transmission line; 62 per cent. when it has passed through the step-down transformer; 57 per cent. when it has passed through the local distribution system and 52 per cent. when it has passed through the service transformer. In other words, about one-half of this unit of heat would be left for effective use as heat on the premises of the consumer.

Then take a pound of coal from a Pennsylvania mine—the whole of this pound is delivered to the consumer's premises. It contains about 2 kw. hours of effective potential heat for which you pay ½ cent on the basis of present price of coal, or ¼ cent for 1 kw. hour, as against 9/10ths of a cent for the kw. hour of heat from Niagara, on the basis of present rates.

Six Steps in Converting Niagara Energy for Heat

This kilowatt of potential heat from Niagara undergoes six distinct steps of conversion before it is delivered on the consumer's premises as heat. The potential heat of the Pennsylvania coal undergoes one conversion only before being put to its ultimate use. The efficiency of conversion from the natural state to ultimate use is probably about the same, but in one case you require a power plant, a step-up transformer; 80 miles of transmission line; a step-down transformer; a distribution system and a service transformer. In the other you require a $200 furnace and a 50 cent shovel. These two conditions relative to the delivery of the commodity must be considered as having a more or less fixed influence on comparative costs, and the only factors which will tend to any appreciable extent to reconcile the present disparity will be an enormous increase in the price of coal, or a compensating reduction in the cost of electric power, assuming, of course, that both commodities will be available for the use under discussion, which is another question altogether.

Then as to service conditions—I think there are about 80,000 buildings in the city of Toronto. It is safe to say that during the extreme weather last winter coal was being burnt in these buildings, for a day or two at a time, at an average rate of four tons per month, or, say, for a two-day period, on several occasions, an average of 270 pounds of coal was burnt in each building in the city. I think that is well on the conservative side. On the basis of this assumption it would require over 1,500,000 horse-power of station capacity at Niagara to heat Toronto in zero weather. Furthermore, on the basis of Mr. Mitchell's estimates of load factor, for two months only 65 per cent. of this power would be used, for two months only 45 per cent., for two months only 20 per cent., and for four months none would be used at all. This is a service condition which is absolutely unheard of at the present time. Under such circumstances an extraordinary operating condition would obtain, in that the load-factor on the generating plant would be mainly controlled by the direction of the wind. On several occasions last winter the rise in temperature due to changing wind direction might have pulled half a million kw. off the station busses over night. Mr. Mitchell has suggested a solution of this load-factor problem as far as the generating plant is concerned, but even granting that industries could be established at Niagara which could economically absorb these enormous quantities of off-peak power, it would not help Toronto, with over 1,000,000 h.p. of installed transformer capacity operating at 35 per cent. load-factor, together with the necessary transmission line capacity to Niagara Falls.

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*Hydraulic Engineer, Ontario Hydro-Electric Commission.

Market Will Develop for Off-Peak Power

In submitting these very approximate figures, I have, of course, not considered the matter of off-peak power. If the price of coal holds at the present figure, or tends to increase, there is undoubtedly a commercial possibility of using electric power as an auxiliary heating medium during off-peak hours, and a rate for this class of service could possibly be fixed sufficiently low to attract some consumers. This phase of the question cannot, however, be discussed very intelligently except at considerable length and on an essentially technical basis.

I may say here that the hypothetical service condition I have just described is one which is certain to obtain in the future at Niagara and at other large hydro-electric power centres, though in a much less acute form. The time is not far distant when the scarcity of power in what Mr. Challies has called the "acute fuel area" will revolutionize the present conditions and rules of service, and a certain class of consumers will develop who will be glad enough to make use, not only of all available off-peak power, but also to take advantage of such power as may be intermittently available during higher stages of flow. Those having to do with the development of hydro-electric power should, therefore, bear in mind that it is only a question of time when the scarcity of fuel and the approaching ultimate exhaustion of hydraulic power resources will make the production of intermittent power not only profitable, but necessary for the public welfare, and permanent works at least should be designed against such a contingency.

Now referring again to Mr. Challies' paper, I think the most important and significant section of the same is that which considers the use of Canada's fuel-power resources according to their adaptability. In considering this phase of the problem we are rather on the horns of a dilemma. Should we consider the advisability or possibility of moving out of the "acute fuel area" such industries as are mainly dependent on coal as a raw material or as a source of power, and of replacing them by industries mainly dependent on water-generated power, or should we look after these industries as best we can by centralized heating plants and out of our future allotments of imported coal? In other words, should the problem of adaptability be attacked on the basis of adapting our fuel power resources to industry as now existing and located, or on the basis of adapting industry to our fuel power resources?

Large Industries May Absorb Excessive Amount of Power

I have in mind one instance which will serve as an illustration of the working of the latter alternative; that is, adapting an industry to our fuel-power resources. Cyanamid, calcium carbide and carborundum are made by processes requiring large quantities of cheap power. They also require large quantities of carbonaceous material which is now supplied in the form of coke made from Pennsylvania coal. There are two points to be considered in connection with this proposition, the most evident being, of course, the necessity of importing coal for such of these industries as are located in the "acute fuel areas." The other point is that the uncontrolled expansion of such industries as these in the vicinity of our large boundary water powers will in the near future absorb capacity that at a slightly more remote period may be urgently needed to keep alive a multiplicity of small industries scattered throughout the territory which is within transmission distance of these sources of power. For unlimited development of large local industries in the vicinity of our large boundary water powers is, therefore, a possible condition of the future which would seem to be undesirable. As against the possibility of such a situation developing in the "acute fuel area" we have, for instance, the Nelson River, a virgin field for hydraulic power exploitation furnishing unrivalled opportunity for the appropriate and efficient location of industry. Three million horsepower of commercially utilizable energy, all more or less accessible to the Hudson Bay Railway, and lying on the very threshold of the Empire's granary. Two million horsepower of this capacity would supply sufficient fertilizer for the whole of the northwest wheat area. Nitrogen and limestone are locally available, and the only important ingredient lacking is carbon. Whether this lack can be made good by western lignite I do not know. That is part of the problem. Crow's Nest coal and Welsh coal, via Port Nelson, would, of course, be available at a price. Here is a problem which is directly in line with the all-important issue under discussion at this meeting, and one which, if intensively studied, would at least serve the purpose of establishing certain fundamental laws which should govern the use of our fuel power resources in relation to their peculiar adaptability. A co-related phase of this study would be to ascertain to what degree the use of the water-powers in the "acute fuel area," more particularly the boundary water-powers, should be controlled so as to preserve an equitable balance between the amounts of power allotted to large local electro-chemical and electro-thermal industries and the amounts of power required, or likely to be required, for general distribution purposes. As a general rule the industrial centres immediately adjacent to the developed power sites will be the first to benefit, but the inevitable result of industrial expansion will be to include more and more of the surrounding territory within the zones of influence of these sources of power, and it is supremely important that these zones shall expand freely along economic lines and not be forced into unnatural channels by private interest or other influences which should have no prior status in the control of a national asset of such magnitude as our water powers.

True Glory of Niagara is its Potentiality

Now, before closing, I would like to mention another matter more or less directly related to the issue under discussion, and which has been briefly referred to by Mr. Mitchell. Probably 90 per cent. of the civilized inhabitants of this planet know Niagara only as a scenic spectacle. Most of them have nevertheless felt the commercial influence of Niagara without realizing it. Their first-hand knowledge of the world's most important water power has, however, been derived chiefly from picture post cards. Since power was first developed at Niagara Falls a continuous campaign of opposition to the commercial exploitation of Niagara has been carried on, based on aesthetic grounds. This opposition has left its mark on legislation on both sides of the line and on the Boundary Waters Treaty. As a matter of fact it is largely responsible for the present shortage of power.

The term "commercial exploitation" may sound cold blooded, but we may as well call a spade a spade, and anyway, in my opinion, the true glory of Niagara lies not in the roar and the rainbows, but in the vast potentiality of the falling waters, considered in the light of an instrument placed in our hands by a Divine Providence for a beneficent purpose, or, as Sir Adam Beck expressed it eight years ago, "to raise the scale of living of our citizens, and to multiply and cheapen the comforts of life." Niagara can have no greater destiny than this, and while aesthetic opposition to the commercial exploitation of Niagara must ultimately fade in the face of these more pressing issues, I think the process should be accelerated as much as possible. I have gone into this matter here because the members of the Canadian Society are qualified by training and vision to propagate this doctrine and let the world at large know what it means. The influence of the Society as a whole would also be a powerful factor in swaying sentiment in the right direction.

Canada's Water-Powers Her Great Asset

Finally, I may say that the papers we have listened to have served to confirm the fact that a world-wide field of commercial enterprise has been opened up which is pregnant with enormous possibilities, and the far-reaching ramifications of its development will work an economic revolution more beneficent in its results than that which took place during the age of steam. I use the term "commercial enterprise" not merely in connection with the exploitation and development of hydro-electric power, but with a much wider meaning, embracing the use of power so derived for the support of a multitude of old and new industries, the production of cheap, sanitary light and heat, and the cheapening of universal necessities, not so much as a result of the cheapness of hydraulic power, but from the fact that power can be made available in such vast quantities as to insure an equally vast increase in the volume of industrial production.

It is not difficult for those here to-day to foresee the commanding position which Canada will occupy in the eyes of the world through the properly controlled and regulated development of her water-power resources and to realize that in the vast potentiality of her boundary streams, and in the equally great, but more widely distributed water powers of her inland rivers, Canada possesses an asset more enduring than the wealth of her mines and forests, or the fertility of her fields, and one which in the end is destined to become the corner stone of an industrial edifice, in the building of which this Society must by right take a leading part.

Possibilities of the Relief of Fuel Consumption by Increased Use of Hydro-Electric Energy

By J. M. Robertson*

The growing necessity for some comprehensive plan looking towards the more complete and efficient utilization of our resources has been apparent for many years to those whose duties make them familiar with the tremendous wastage of materials which results from the lack of coordination in the use of the various raw materials with which our country is so richly endowed. The public, generally speaking, has little real idea as to what constitutes the essential of conservation of natural resources. Simple reduction in demand, the restriction of the use of such materials, thereby restricting the output of essential industries is obviously not true conservation. The goal to be aimed at is development, present and future, and in order to secure this end we must make use of such materials as are necessary for the maintenance of our trade and commerce and the growth and development of our national life. Economic utilization of such resources, considering both present and future, would limit the use of irreplaceable materials even though they might be more cheaply and readily obtained under given conditions, and promote the use of other materials whose use conserves to a greater extent the assets of the community.

Consider Other Factors Besides Cheapness and Availability

The elements of cheapness and availability of raw materials are large factors in determining the success or failure of any industrial enterprise, and as such must be given due weight. We have been, however, and we are still, too much inclined to accept these factors as excuses for taking the material nearest at hand which is suitable for our purpose and letting the future take care of itself. A little thought and investigation devoted to the development of possible substitutes will frequently disclose methods by which an industry may utilize materials or processes the use of which does not deplete the resources of the country. The ideal conservation would provide for the maintenance of the industries of the world by the use of basic materials supplied from natural growth so that the stock of raw material which constitutes the capital of the world would not be reduced but would be handed down unimpaired from generation to generation.

Such an ideal conservation is obviously beyond reach in our present stage of development, but, although we are still using up our capital at an alarming rate, the increasing realization of the need of care and the increasing efficiency of utilization which science is placing in our hands makes the future look more hopeful than might be considered warranted by a consideration of the special and temporary restrictive measures which have been applied to industry as a whole during the past few months. From these experiences it is apparent that the most essential elements in our industrial life at present are transportation and fuel, and to a large extent transportation means fuel, since the equipment required for transportation can neither be produced nor operated in the absence of an adequate supply of fuel. It therefore follows that any modification of our past practice which will maintain our industries and at the same time reduce the consumption of fuels will be an application of true conservation principles in more than one way, as first, it will reduce the consumption of a material which once used cannot be replaced, and secondly, it will reduce the demand for transportation for such material and will thereby leave for the use of some other industry a larger supply of raw material for which for its purposes there is no substitute.

Use of Raw Coal for Power Generation Uneconomic

The use of raw coal as a basis for the generation of power through the medium of steam is fundamentally uneconomic, as too large an amount of valuable by-product is sacrificed for very little return, and the efficiency of the conversion is much too low. When it is considered that under average conditions the amount of coal required to generate a horse-power hour is of the order of five or six pounds, representing an efficiency from coal to power of only three or four per cent., which, generally speaking, must be again divided by two before the energy is applied to the work it can be readily realized that our present methods of operation leave much room for improvement. In defence of the steam plant it may be claimed that such figures represent only the practice of the smaller plants and that in the large manufacturing centres power is supplied from steam plants which operate much more efficiently. It is a very good plant which can average a kw.hr. on 1½ lbs. of coal, including all auxiliaries, so that even under the best conditions we get an efficiency only about 15 per cent. It is, of course, necessary to remember that such low efficiencies are not due to imperfections in the equipment, but rather to the limitations imposed by thermal laws, and until a method of conversion radically different from the present has been discovered such losses cannot be eliminated.

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*Consulting Engineer, Montreal, Que. before Professional Meeting, Can. Soc. C.E.

These figures, unsatisfactory as they are, tell only half of the story. In using raw coal we are throwing away in a wasteful manner material which contains many valuable by-products which add but slightly to its value as a fuel, but which when extracted have a value greater than the value of the coal itself. Many of these materials are essential elements in our industrial life for which at present there are no substitutes.

Notwithstanding this very unsatisfactory showing, the necessities of the case require that coal should be used for fuel in the absence of better means of providing readily available energy. It would seem, however, more or less elementary that the use of coal for such purposes should be restricted to cases where no substitute is available in order that when science places in our hands improved means of converting fuel into power, we shall not be in the unfortunate position of having squandered our patrimony and left ourselves without the means to take advantage of the improved processes when available.

Generate Power Before Using Steam for Heat

Climatic conditions in this country owing to the northern location impose upon us a heavy burden every winter. Heat must be maintained in our houses and shops. At this stage of progress the only generally available means of heating is by fuel—coal, oil or gas—of which the former is by far the most important. We cannot avoid the use of coal for heating our factories, but we can see to it that as soon as practicable raw coal is not used for this purpose, and that what fuel is used is for heating purposes only wherever adequate substitutes for coal generated power are available. Too many of our industrial establishments are operated entirely by coal simply because the controlling head likes the idea of "independence," and declines to consider the purchase of public service supply because he would then be "dependent on the power company." In places where hydro-electric service is available the power required by such establishments should be purchased and generally is purchasable at rates and under conditions more favorable than the costs of operation by coal and with much less investment for plant. In the cases of factories located where such service only is obtainable sufficient engine plant should be installed to make possible the abstraction of the maximum amount of energy from the steam before it is used for heating, the idea being to operate steam plant only to the extent of the heat requirements utilizing the steam equipment as the reducing valve and increasing or decreasing the purchased power to such an extent as may be required to offset the variation in the by-product power recovered from steam required for heating or process work.

As the average manufacturing establishment in most parts of Canada requires more steam for heat than for power during the winter months and almost no steam during the summer months, and as the demand for electric energy for lighting purposes is much greater during the winter, such an arrangement works to the advantage of both company and consumer as the combination makes possible the almost ideal utilization of the energy in the fuel during the winter and the capacity on the power system thus released becomes available to take care of the increased load which must be carried electrically. The diversity thus introduced into the power demand makes possible the fixing of a power rate which is attractive to the consumer, and, at the same time, remunerative to the power company.

In some plants considerable ingenuity is displayed in so combining equipment for utilizing steam, electricity and compressed air or refrigeration with outside service so that no fuel whatever is burned, except for supplying heat, and every possible unit of energy is abstracted from the steam before it is utilized as heat. Variation in the demand for air and electricity is compensated for by use of machinery driven by two sources of power involving very interesting cross conversion of energy.

The experience of those who have plants operating under these conditions is quite satisfactory as they have secured the convenience of freedom from unnecessary heat and dirt during the summer, the advantage of a standby plant as protection against shut down—extremely low cost of power during the winter and a satisfactory power service available at all times when required.

The fact that such economies are usually realized in plants of considerable size is due principally to the fact that the large plants are directed by executives of broad views who realize that elimination of waste is desirable even though in a given case it may not result in a net saving of money.

Instances have arisen this year in which factories which operate by steam power in winter and purchase hydro-electric power during the summer months have anticipated the date for the commencement of this purchased service with the consent of the power company, and are reducing their coal consumption as weather permits, to the minimum absolutely necessary for heat, and are paying to the power company for service to make up the deficiency in power recovery the net amount they would have paid for additional coal. The power company having power available is satisfied to accept this amount for temporary service from month to month without further obligation on the part of either party. Such co-operation shows evidence of broad-mindedness on the part of all concerned and leads us to hope that further progress in co-operation would develop many other instances in which very real savings could be made to the advantage of the country as a whole.

An indication of the extent to which an enlightened policy under favorable conditions can carry the substitution of hydro-electric service for steam in an industrial community is given by a comparison of the figures representing the consumption of electrical energy in the more important industrial centres in America. For the year 1916 the figures in kw. hours per head of population were as follows:—

New York, 225; Philadelphia, 250; Boston, 350; Cleveland, 400; Minneapolis, 450; Pittsburg, 500; Buffalo, 586; Toronto, 700; Montreal, 783. The figures for 1917 are not yet available, but it is probable that the figures for both Toronto and Montreal would show an increase of about 10 per cent. Montreal would thus be about 800, while the whole province of Quebec was about 700.

The total power utilized in the Montreal district is about 200,000 h.p., of which about 165,000 is supplied from hydro-electric sources and the balance by steam. If the city pumping plant and the plant of the Tramways Company are excluded, the total steam capacity now in regular operation in this territory would be about 10,000-12,000 h.p., or about 5 or 6 per cent. of the total power utilized. Even this small part of the demand would be reduced materially were it not for the fact that most of these plants are of a kind which produce large quantities of combustible waste which must be disposed of by burning or are plants in which there is relatively large demand for high temperature steam for process work and a relatively small demand for power.

When it is considered that the amount of coal required to replace the electrical energy supplied by these hydro-electric plants would be of the order of 1,750,000 tons per year it is clear that while there still remains much to do a very considerable amount has been done.

It should be borne in mind that this is no isolated instance, what has been done here is being done to a greater or less extent in many other centres as is clear from the large and increasing load carried by the Hydro-electric System in Ontario. Toronto's use of current is almost equal to that of Montreal, and both of them are quite remarkable for very complete utilization of purchased power. Co-operation between the consumer and the company with fair rates and conditions for service rendered, and a reasonable willingness on the part of the consumer to adapt himself and his plant to new conditions, even when such adaptation may perhaps entail the sacrifice of a little of his apparent independence, will assist our power companies in improving the already high character of the services they are now rendering by reducing to a minimum the utilization of irreplacable materials and extending and broadening the use of power from inexhaustible natural sources.

The development and utilization of our water power reserves is a measure of our economic advance in the scale of civilization, and the formulating of a broad and liberal policy which will ensure the keeping of such development in advance of the requirements of our industries is something which should engage the attention of our government and our industrial leaders.

It is surely not too much to hope that in a country so richly endowed with natural power sites, distributed almost ideally from an economic standpoint, the time will come when practically all of the power required for our industrial life will be supplied from such sources, and we will be free from the reproach that because it is easy and obvious we cheerfully squander our patrimony while we neglect to develop the natural heritage with which a wise Providence has blessed us.

Central Heating as Means of Conserving Fuel

By F. G. Clark*

Central heating is the replacement of two or more individual heating systems by one source of heat. The electric central station and the gas generating plant are illustrations of central heating to the extent that their respective forms of energy are used in connection with heating appliances. The use of electric energy and gas for this purpose is being dealt with in other papers which probably means that the writer is expected to deal only with steam heat distributed from a central generating plant. As the subject probably covers steam for power, providing it comes from a central plant, this enlargement will be made. We therefore have as our subject central steam plants as a means of conserving fuel by replacing isolated power and heating plants.

The first commercial central steam plant was installed by Holly previous to 1880, and although many others have taken a hand in the business, the company founded by him furnishes most of the special materials for the installations and frequently does the work of installing. The systems installed by Holly and his successors were generally high pressure systems. There have been a few exhaust steam or low pressure systems, and there is also here and there a hot water system. The hot water system possesses advantages which, however, are restricted to local conditions.

The relative merit of high versus low pressure systems has been the subject of much discussion. It appears that the high pressure systems were originally installed before electric energy became an important competitor of the steam engine. The central steam plant was generally able to substitute its service for the boilers of the consumer, and although the steam engine is no longer an important factor, the high pressure system remains in a number of large cities, and probably for the reason that the generating plants have high pressure boilers, and the street main cost of low pressure piping is high in comparison. The ideal system would take low pressure steam from a steam electric power plant. The steam would be taken from the low pressure stage of steam turbines through suitable regulating valves, and be superheated by a suitable heat exchanger before passing into the street mains.

The conditions which best suit this method of supplying heat, are a closely built up section of a city and a central location for the supply plant. The location of the station and the congested area usually gives a fan-like distribution system. As an economic proposition the central heating plant can offer to customers in a limited district a supply of heat for approximately what their coal would cost them, leaving a fair return on the central heating system investment. The purchaser of steam avoids the necessity of purchasing and operating boilers, saves the space they and the fuel would occupy and is free from the troubles of operation. Steam mains laid in city streets, while not entirely free from troubles, usually give ample warning of failure, and can be depended upon for continuous service.

The loss of heat is a more or less constant quantity, depending upon the length and size of pipe, its insulation, the difference in temperature of steam in the pipe and the surrounding earth, and the leaks. The nearer to capacity the mains are worked the smaller is the percentage of loss. A well-designed system, as for example, one covering that part of Toronto between the bay and College Street, and from Sherbourne Street to Spadina Avenue, if supplied from a central plant such as the Scott Street Station of the Toronto Electric Light Company, would be able to furnish all of the heat required in the district at a cost to the users from 10 to 30 per cent. less than their present expense. The saving in coal might be over 30 per cent., but in any case the cost of coal at the central plant would be sufficiently less than its cost delivered throughout the district to offset the fixed charges and heat losses of transmission through the streets.

On the assumption that 75 tons of anthracite at $9.00 a ton, and 150 tons of bituminous at $7.00 per ton is used in the district each week day for six months, and proportionately smaller quantities during the remainder of the year, the cost of steam under present conditions would be over $500,000 per year, of which the coal cost is about $400,000.

The central heating company would be willing to supply an equivalent quantity of heat for the cost of the coal, depending upon their own saving in coal and its cost to meet expenses and pay a dividend.

The conditions throughout Ontario and the populated parts of Quebec are ideal for the development of central heating plants because of cheap electric power, the number of heating days and the high price of coal. Every town of 10,000 or more inhabitants and with buildings not too widely scattered affords an opportunity for saving coal if it will support a well designed and well operated central heating plant. The smaller towns should depend upon hot water circulation, the water being heated during the hours when electric energy could be taken from steam engine units used to produce the exhaust steam needed for heating. The Hydro municipalities could use some of the energy they have been expending upon the radial railway scheme in the solution of this problem, and produce an economic saving of value to themselves and the country.

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*Chief Engineer, Toronto Power Company.

I would not care to make an estimate as to the saving that would result from a comprehensive establishment of central heating plants throughout the country. It is altogether improbable that any installations will be made in the immediate future. The idea of cheap hydro-electric power unlimited in quantity and in its capacity to replace coal has so taken hold of the people of Canada and of Ontario in particular, that they are simply waiting for the end of the war or the completion of the Chippewa development to heat their buildings electrically and thus entirely do away with coal. I will, however, venture one prediction which will have a considerable bearing on the question of central heating, or rather on heating in general. It is, that within ten years, gas and coal briquettes will replace the anthracite and bituminous coal now used and that the gas and the briquettes will be made from powdered coal sent from the mines to Hamilton or Toronto or London in pipes, just as oil is now pumped from Oklahama to the Atlantic Seaboard. The cost of the gas and the briquettes will be less than one-half and possibly one-fourth the present prices for gas and coal. What the situation with respect to the central heating will then be is left to your imagination.

Mainly Constructional

East and West—From Coast to Coast

Plans have been prepared for a new shipyard at St. John, N.B., for the St. John Shipbuilding Company, Limited.

The permits issued in Galt, Ont., during March are valued at $7,640, and include 4 dwellings, 5 barns and garages and 2 additions.

For Toronto harbor improvements an item of $500,000 has been included in the Dominion Government estimates. There is also a revote of $200,000.

Building permits amounting to a value of over $500,000 were issued in Toronto during the month of March. In the same month last year, the total was $414,708.

The Nanaimo city council has decided to extend the sewerage facilities of the city, and will install a system on five streets and on portions of other thoroughfares.

The bricklayers of Vancouver have decided that they are not getting enough money for their labor, and after May 1st they will demand $7 for a day of eight hours.

The Bricklayers' Union in Toronto have decided to demand an increase in wages. Notice will be served on all the master builders in the city that the rate of wages is to be 70 cents per hour on and after May 1.

The Canadian Steel Corporation has been licensed as an extra-provincial company in British Columbia. The corporation's head office for the province is in Victoria. Their Dominion headquarters are at Ojibway, Ont.

The building permits issued in the month of March in Welland, Ont., are valued at $6,030, as compared with $31,165 in the same month last year. The total for the three months of 1918 is $31,640, as against $41,880 in the corresponding period in 1917.

The huge telescope being erected by the Dominion Government at Saanich Mountain, near Victoria, has at last been completed, and Dr. J. S. Plaskett, who is in charge of the observatory, has gone to Pittsburgh to carry out the final tests, prior to shipment of the 4,300 pound mirror to Victoria by express.

During the month of March there were 36 building permits issued in Windsor, Ont., valued at $72,285, which compares with 47 permits valued at $106,155 for the same month in 1917. The permits for the first quarter of this year are valued at $100,375, as compared with $188,965 for the corresponding period last year.

Among the building permits issued in Toronto recently is one for the erection of a stores dépot for the Imperial Munitions Board on the Weston Road, near St. Clair Avenue, at an estimated cost of $125,000. Another has been taken out by Imperial Oil, Limited, for a petroleum storage station on Keating street to cost $104,200.

New military barracks for the accommodation of 1,000 soldiers will probably be erected in Toronto for the accommodation of men returning from overseas. Coupled with the difficulty in securing accommodation for convalescent soldiers, the authorities are experiencing trouble in finding room for men sent back from overseas for discharge.

The united counties of Durham and Northumberland have come into the Ontario good roads system, according to an announcement recently made by Mr. W. A. McLean, Deputy Minister of Highways. Their present plans include 390 miles of highway. This leaves only one county in the province outside the good roads system—the County of Peterboro.

The Merchants' Bank of Canada will erect a four-storey building at 12-16 King Street West, Toronto, at an approximate cost of $250,000. The land has a frontage of 54 feet and a depth of 90 feet, and is assessed at $5,250 a foot. Owing to the fact that certain leases of the present properties have some months to run, construction may not commence until next year.

Concrete slabs to replace sections of wooden sidewalk as they require renewing is a suggestion made by Alderman Bacchus, New Westminster. Mr. Bacchus' idea is that on days when weather conditions prohibit the board of works men from doing outside labor they may be employed making a supply of concrete slabs. Lumber being very dear and short-lived, he thinks this plan might prove more economical.

The largest constructional work being carried on at the present time in the vicinity of Winnipeg is the aqueduct for the water supply of the city and surrounding municipalities. At the end of 1917 $1,275,587.96 had been expended on the work. In the spring of 1915 the construction was commenced and during that season 12.3 miles was built, or 14.6 per cent.; during the 1916 season 23 miles was built, making 41.6 per cent. of the portion east of Deacon complete. This work will be pushed forward with all possible speed until final completion, which is hoped for in the fall of 1918.

About the middle of March thirty carloads of engine parts for the fleet of wooden ships being built in British Columbia for the Imperial Government arrived in Vancouver to be ferried across to the assembly plant at Ogden Point, Victoria. At the same time three Eastern-built boilers which arrived some time ago were also sent forward. It is reported that the engines are arriving in a semi-finished condition and that the mechanics have to spend considerable time in putting the finishing touches on them. It is the intention of the plants to deduct the cost thus added from the price of the engines.

The ratepayers of Windsor, Walkerville, Ford, Sandwich and Ojibway have endorsed the proposal to construct a new trunk sewer connecting the municipalities and preventing the pollution of their water supply. The by-law provides for an expenditure of $210,300 for the building of an intercepting sewer which will carry out all sewage below the waterworks intakes. The sewer will be in two sections, the easterly portion extending from the town of Ford to Parent Avenue in Windsor, emptying below the Windsor waterworks intake.

The other section will serve Ojibway, Sandwich and Sandwich West. The cost of the work will be apportioned among the municipalities as follows: Windsor, $26,200; Sandwich West, $28,333.33; Sandwich Town, $25,333.34; Ford, $65,300; Ojibway, $46,533.44.

The annual statement of the Steel Company of Canada, which has recently been issued, shows the company to be in a very strong position financially. Unknown deductions having been made from the sum of the firm's earnings to cover repairs, maintenance, improvements to plants and allowance for war tax. the profits for the year are shown as $6,040,318, an increase of $1,018,927, or 20.29 per cent., over 1916. In comparison with 1915 the increase is $2,809,866, or 86 per cent. After provision for sinking fund allowance, bond interest charges, and a full year's dividend on the preferred stock at the rate of 7 per cent., the balance of earnings applicable to the common stock was $3,686,843, an increase for the year of $640,461, or 21 per cent. The most striking feature of the balance sheet is the expansion in the value of inventories by $2.200,000, due largely to higher prices and to the larger business.

Work is not quite complete on the sewer system at Trail, B.C. Up to the end of March there had been laid 20,925 lineal feet of 15 inch, 12 inch and 8 inch sewers and 72 manholes. Some further extensions will be made this spring; it has not been decided yet just how much—probably about 3,500 feet. In connection with the new waterworks system for Trail, there has yet to be completed the distribution reservoir and the Violin Lake storage reservoir. In the case of the former the work is about two-thirds complete, and in the meantime the reservoir on the old system is being utilized, the new supply from Cambridge Creek having been in use since October 1, 1917. At Violin Lake storage reservoir the conduit pipe line has been completed. The dam at the outlet of the lake, however, has yet to be constructed; also the land which will be flooded has to be cleared.

About 120 feet of the main section of the London, Ont., waterworks dam in the River Thames, some five miles west of the city, collapsed recently. This was the result of its having been undermined by the spring freshet. For some time the hole beneath the foundation had been rapidly widening and nothing could be done in a temporary way to relieve the situation, because of the fact that the breach was in midstream and the river has been more or less in flood since the break-up some weeks ago. The dam was built in 1895, at a cost of $50,000. Nothing can be done to repair the damage until permanent reconstruction is undertaken during the summer. The dem had enabled the city to generate 500 h.p. for the purpose of conserving Hydro power, and in addition, pumping was done for the waterworks system in a large-capacity plant. However, the Hydro power is interconnected and is being utilized without any dislocation of the waterworks supply.

Personals

Mr. John G. Sullivan, chief engineer of the C. P. R. lines west of Winnipeg, has been re-elected president of the American Railway Engineers' Association, at the annual meeting held at Chicago.

Mr. R. O. Wynne-Roberts has been appointed consulting engineer to the town of Sault Ste. Marie, Ont., in connection with the installation of a new electrically-operated pumping station.

Mr. A. F. Cotton, of New Westminster, has been appointed municipal engineer of Surrey, B.C., succeeding Mr. J. H. O'Hara, who has resigned to take up new duties.

Mr. Thomas Adams, town planning engineer, Ottawa, is to assist the town planning section of the civic bureau of the Board of Trade in Vancouver, in preparing a town planning act for British Columbia that will likely be passed by the government at Victoria during the present session.

Mr. W. H. Winterrowd has been appointed chief mechanical engineer of the C. P. R. in succession to Mr. W. E. Woodhouse, who has resigned. Mr. Winterrowd was formerly assistant chief mechanical engineer to the company, which he joined six years ago. He accompanied Sir George Bury to Russia.

Mr. Frederick E. Field. the chief engineer of the Montreal civic filtration plant, has asked the Board of Control for indefinite leave of absence, in order that he may take a position under the Housing Department of the United States Shipping Board, Washington. This body has the control of laying out the housing accommodation for the shipping forces of the United States.

John Laxton, harbour commissioner, of Toronto, and E. L. Cousins, chief engineer and manger of Toronto Harbour Commission, were in Vancouver during the early part of March. Their visit was in the nature of an enquiry into Vancouver harbour conditions. While in the city they conferred with City Engineer F. L. Fellowes regarding his suggested plan to develop the upper basin of False Creek. Mayor Gale entertained the visitors to luncheon.

Obituary

Mr. John G. Poupore died at the General Hospital, Montreal, on March 23. He was for many years a partner of Mr. W. J. Poupore, contractor, Montreal, but retired in 1900.

Mr. J. B. Brophy, M.C.S.C.E., died in Cornwall on March 31st, following a stroke of paralysis, aged 73. He was a canal engineer, and lately was connected with the engineering staff of the Cornwall Canal; he was formerly resident engineer of St. Peters Canal, St. Peters, N.S.

New Book

Relief from Floods—By John W. Alvord and Charles B. Burdick; McGraw-Hill Book Co., Inc., publishers; price $2.00 net. This book explains the fundamentals of flood prevention, flood protection and the means for determining proper remedies. It is not intended as a treatise, but rather as an outline of the general flood problem in all its many phases, showing what remedies can be applied and pointing the way to the selection of the proper works. Technicalities have been avoided for the most part and the subject matter will be readily understood by readers who are not engineers. The chapter headings are as follows: The flood problem; various means for relief; flood investigations; fundamental data; future floods; flood protection by channel improvement; flood prevention by water storage. Size, 6 x 9 in.; 170 pages; cloth cover.

Trade Publications

The Federal Engineering Company, Limited, Toronto, are issuing monthly a little booklet entitled "Belts." It contains information for uses of belts, talks on the modern special purpose and special service belt, talks on factory economics, etc.

Marine Specialties—Part catalog No. 1005, dated January, 1918, by T. McAvity & Sons, Limited, St. John, N.B., describing McAvity marine specialties, to pass British Admiralty, Lloyd's and Imperial Munitions Board's specifications. This catalog is an endeavor to list as many as possible of the marine valves, fittings, hardware, etc., as are used in the building and maintenance of steamers and vessels. Splendidly illustrated.

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Government Will Now Establish a Briquetting Plant

TARDY action has at last been taken by the Dominion Government on the recommendations of the Advisory Council for Scientific and Industrial Research. Several months ago the Advisory Council made an investigation through a sub-committee, of which Mr. R. A. Ross, C.E., of Montreal, was the chairman, of the possibilities of utilizing the coal supplies of Western Canada at points other than those in the near vicinity of the deposits. It is unfortunate that, while we have immense deposits in central Western Canada, this coal is of a very poor quality. It crumbles very rapidly when exposed to the atmosphere and so is not fit for shipment to any great distance. It is doubtful if any Alberta coal came farther east than Winnipeg last winter. In Ontario the situation is very acute owing to our geographical position, and we can expect little aid from the Western province.

The investigations of the Advisory Council proved the possibilities of briquetting lignite into a more permanent form suitable for shipment to greater distances. Therefore, the Advisory Council recommended that the government expend $400,000 in the erection of a briquetting plant. These recommendations were made during the early summer of 1917, but it was only after the critical fuel condition of last winter that any action was taken on these recommendations and just recently the government announces that there is now set aside $400,000 for the plant. Operations in the coal fields, owing to the unstaple nature of the product, have been carried on in the past only during the winter months. It is hoped that mining will become continuous when the briquetting plant is in operation.

Nobody Can See Reason in Fuel Controller's Order

AS a result of the suffering in Central Canada during the last few months from fuel shortage, causing the closing down of many of our vital industries, the Fuel Controller has isued an order instructing householders and others who lay in a stock of coal for the coming winter that they can only purchase up to 70 per cent. of last year's requirements. When the companies are approached for an advance supply of coal the customer is asked: "How many tons did you use last year?" If his answer is, say, "Twenty tons," he is booked for fourteen tons, and this amount will be supplied as soon as incoming shipments make its distribution possible.

If it is difficult to understand what the gain will be from this method of procedure. It is evident that under the conditions which prevailed last winter very few establishments consumed more fuel than was absolutely necessary. In many instances a reduction of 30 per cent. would simply mean the closing of plants and homes. If the circumstances which existed last winter, when a considerable percentage of our people had supplied themselves beforehand with their full requirements and it remained only for the various dealers to supply the less provident proportion of their customers—if, under these circumstances, the supply of coal was inadequate, how much greater will the problem of supply be next winter, when there will be, in addition, the 30 per cent. of the demand of the forehanded customers also to be brought in and delivered.

The Fuel Controller may hold the opinion that if those who were in the habit of laying in a supply for future needs were prevented from drawing to the full extent of their requirements this might lead a certain percentage of the improvident to buy earlier in the season. However, forecasts regarding the probable shortage of fuel were freely expressed last summer, and were taken sufficiently serious to induce anyone so inclined, or who had the ready money, to lay in such a stock as he required. It seems entirely unlikely that a greater number will avail themselves of this opportunity during the coming summer. The Fuel Controller's order seems to mean that the dealers who previously have urged their customers to take summer delivery, because it is their slack period, will be forced in a greater degree than ever during the present summer to keep their staff and distribution forces in idleness.

This is, undoubtedly, the way the Fuel Controller's order appeals to the average person. It is also, so far as we can learn, the situation as understood by the dealers themselves. If the controller has any other interpretation of this order, he has failed, unfortunately, to take the public into his confidence.

Canadian Good Roads Congress May 7-10

Practically no heavy machinery will be exhibited at the Canadian Good Roads Congress at Hamilton on May 7-10. This is mainly due to transportation difficulties. A preliminary programme of subjects to be discussed has been arranged. These include "Who Should Pay for the Roads?" "Roads and the Farmer," by a professor at one of the Agricultural Colleges; "The Efficiency of the Highway in the Present Transportation Difficulties," and "The Most Important Consideration on Road Construction—Drainage." Mr. W. H. Corwell will read a paper on "The Results of Tests with Various Types of Pavements," giving data on a test road, 15 miles long, near Philadelphia, in which 20 types of pavement were tested. A very timely paper on "How the Good Roads of France Are Helping to Win the war" will be contributed by an officer who has built military roads at the front. "English and American practice in the construction of Tar and Concrete Roads" will be the title of another paper; while other subjects will be "Abatement of the Dust Nuisance;" "The Roads of the Common People—Gravel and Macadam," and "Labour Shortage Solved by Efficient Machinery."

High Tension Phenomena at the A.I.E.E.

ONE hundred and ten members of the Toronto section of the A.I.E.E. were privileged to see, at the Hydro-Electric Laboratories last Friday, actual demonstrations of testing at 250,000 volts, the use of the sphere gap for measuring high voltages and the formation of corona. The occasion was a paper by Mr. W. P. Dobson, director of the laboratory, on "High Voltage Phenomena," and the experiments contributed greatly to the attractiveness of the subject. In Mr. Dobson, it was clear, the section boasts a member who is a physicist of considerable attainments and a mathematician of no mean order. The paper, which was devoted to a discussion of high voltage measurements, the corona voltmeter, corona losses, and the effects of switching on high tension lines, showed much thought in its preparation and a careful study of the work of recent investigators of the subject. An interesting test demonstrated the reliability of the sphere gap in comparison with the needle gap for measurement at different frequencies. The demonstration was an indication of the valuable work that might be accomplished in the commission laboratories in the direction of standardization and research at high voltages.

Developing Mineral Resources of Canada

THE first meeting of the associate committee on mining and metallurgy of the Council for Scientific and Industrial Research, was held recently in Montreal, when steps were taken for the further development of certain of the mineral resources of the Dominion and for the utilization of a number of waste products which are being developed in Canadian industries.

The meeting resulted in definite action being taken on certain projects which were discussed. Among these is the investigation of a new method of smelting iron, employing both coke and electric power. This promises to be especially suitable for the smelting of certain Canadian ores occurring in the vicinity of large supplies of available water power. The Research Council has already made a grant for the prosecution of this work, and the preliminary investigations will at once be carried out at McGill University for the development of a commercial process for the production of high grade domestic fuel from sawdust. This is now being produced on a small scale in British Columbia, but it is believed that it may be capable of development to great advantage in other parts of the Dominion where there are larger amounts of refuse sawdust and wood now being wasted.

The utilization of refuse from sheet steel and galvanized iron, of which large amounts are now waste products in various factories of the Dominion, was also discussed.

Mr. Lesslie R. Thompson, B.A.Sc., A.M.C.S.C.E., who is at present on the staff of the Dominion Bridge Company, has been appointed secretary to the Honorary Advisory Council for Scientific and Industrial Research.

Montreal's Civic Commissioners

The Quebec Government has appointed the following as commissioners for the civic government of Montreal, under the plan passed at the late sitting of the legislature: Mr. Ernest Decary, notary, chairman; Hon. Charles Marcil, M.P., recently elected alderman; Messrs. R. A. Ross, consulting engineer; Alphonse Verville, M.P., labor representative; and Charles Arnoldi, civic treasurer. Mr. Ross is a widely-known engineer, a vice-president of the Canadian Society of Civil Engineers, who has been chiefly identified with hydro-electric work. Recently he has taken a leading part in the solving of the fuel problem, and has devoted much time to the question of utilizing, commercially, the vast deposits of lignite in the West.

Railroad Equipment Contracts

According to a parliamentary return, the Hart-Otis Car Company, Ltd., of which Mr. F. H. Hopkins, Montreal, is second vice-president and general manager, have obtained an order from the Canadian Government for 450 fifty-ton capacity improved Hart convertible ballast and construction cars, worth about $1,385,000. Two hundred and fifty of the cars are side dump cars and two hundred side and centre dump cars. The cars are to be manufactured in Canada, and will be used in the maintenance and construction of the Canadian Government and Canadian Northern railway lines. This is part of the large equipment order placed about the middle of March, and in which the Canadian Car and Foundry Company participated to the extent of nearly $15,000,000. Other orders placed at that time were as follows: Eastern Car Company, Trenton, N.S., 750 forty-ton steel frame flat cars and 650 fifty-ton steel coal cars, worth $3,750,000. The National Steel Car Company, Hamilton, secured 1,000 forty-ton steel frame box cars, valued at $2,750,000.

Contracting Firm Reorganized

The Loomis-Dakin Construction Company, Ltd., which was recently formed to take over the general contracting business which has been carried on by Loomis-Dakin, Ltd., has for its officers the following: President, F. W. Dakin; vice-president, S. G. Newton; treasurer, L. A. Dakin; secretary, C. W. Cate. Loomis-Dakin, Ltd., will continue to carry on special trades, such as plumbing and heating, painting, glazing, etc.

Mechanical Filtration Plant for City of St. Hyacinthe

MESSRS. ARSENAULT & PLAMONDIN, Ltd., are completing a mechanical filtration plant for the city of St. Hyacinthe, P.Q., from plans by Mr. F. E. Field, M.C.S.C.E. At present the city, whose population is 12,000 persons, is supplied with water from the Yamaska River, which is treated with chlorine, and the plant now being finished is, in fact, an addition to the present equipment, converting it into a modern filtration plant. The old system consisted of boiler, pumping, and power buildings, with two steel pressure filters.

The new work includes a pumping room, filter building, the remodelling of the pumping arrangements, and head house (containing laboratory, chemical room, office, etc.). All these buildings are connected. The filters have a total capacity of four million imperial gallons per day, the clear water well one hundred and ninety-three thousand imperial gallons, and the coagulation basins four hundred thousand gallons. New pumps are to be installed, and these, with the old pumps, give a capacity of eight million gallons of raw water daily, six and a half millions domestic water, and seven and a quarter millions for fire service.

The old 20-inch suction pipe is utilized, and it has been lengthened to connect up with the new pumping room.

Considerable Excavation Involved

The buildings are of reinforced concrete, with the exception of the superstructure of the filter building, which is of brick. A large amount of excavating had to be done, the work being carried out by means of a steam derrick and Scotch derrick. The soil is a blue clay, and, owing to an exceptionally rainy season, the excavation proved to be more difficult than had been anticipated. The soil was carted to the river side and dumped. The ground was excavated to a depth of 19 feet for the clear water well, 10 feet for the coagulation basins, 22 feet for the suction well, and 15 feet for the pump room. In connection with the latter the walls of the old pumping station were underpinned, this work being done while the pumps were in operation. The excavating of the trench in the head house for the main pipe was another portion of the contract that involved careful work. The trench was dug three feet distant from the existing brick chimney, 65 ft. high, which was built on the blue clay practically without any foundation, going down to a depth of only five feet. The trench was 17 feet deep, and had to be solidly braced with lumber as the work proceeded. The work was done during December, and was the most difficult part of the entire job.

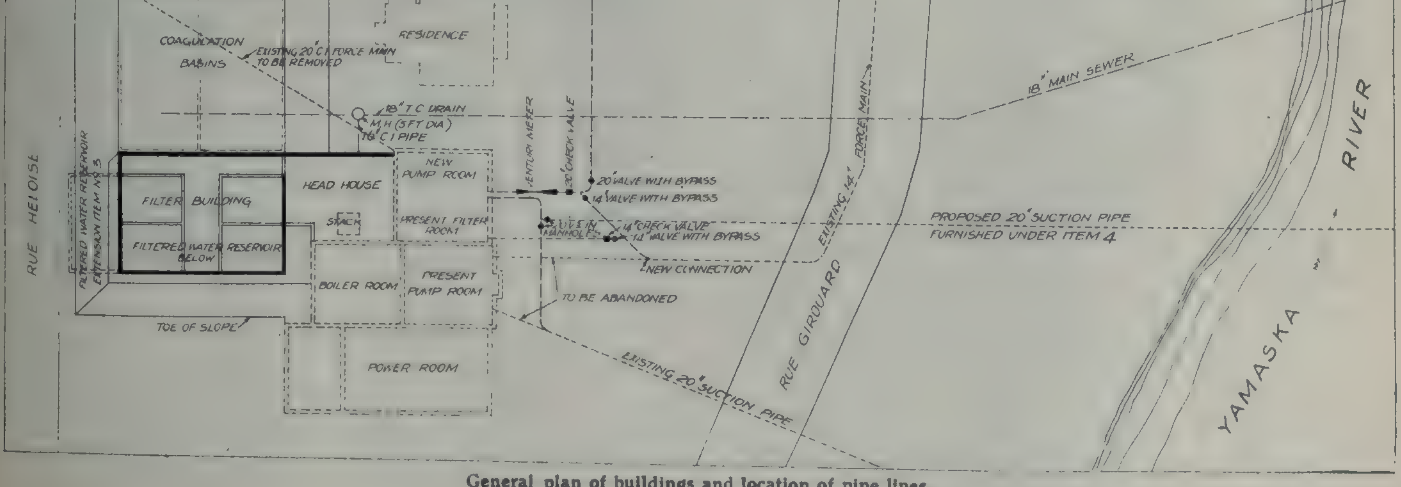
Three Different Mixes of Concrete Used

For general work three classes of concrete were used—"A," consisting of one part cement, two of sand, and four of ballast; "B," one cement, two and a half sand, and five ballast; "C," one cement, three sand, and six ballast. "A" was used in the walls, piers, and roofs of the coagulation basins, the filtered water reservoir, filter and chemical tanks and reinforced floors; "B" in footings and floors of the coagulation basins and filtered water reservoir, pump foundations, and foundation walls of the pump room; "C" around pipes and trenches and in other places where additional support and not water-tightness was required.

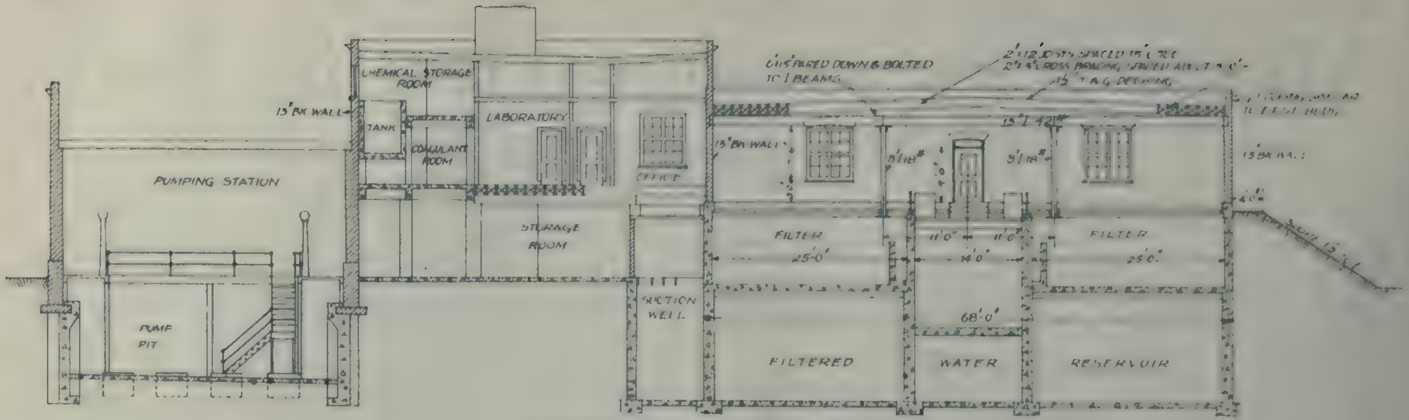
The filter building (32 x 66 x 18 feet) and head house (44 x 36 feet) have deck roofings of 1½-inch tongued and grooved lumber, with galvanized iron flashings. The roof covering is of gravel and pitch, laid on saturated felt, to Barrett specification. The cornices are of galvanized iron, the galvanized rain conducters being 4 inches in diameter.

The floor of the chemical room is of reinforced concrete, and the floors of the other rooms in the head office are of wood. Walls and ceilings are of plaster.

The four 8-inch low-lift pumps are designed to



General plan of buildings and location of pipe lines.



Elevation St. Hyacinthe filtration plant.

pump against an overall head of 40 feet. They are to be direct connected in pairs to 2,200 volt, 1,200 r.p.m. a.c. motors, in such a manner that any pump may be cut out of service. These pumps each have a capacity of 1,500 imperial gallons per minute. The 12-inch wash-water pump has a capacity of 3,500 imperial gallons; the 8-inch domestic pump, 1,500 imperial gallons; the 10-inch booster pump, 3,000 imperial gallons, and the 2-inch sump pump, 50 gallons. All the pumps, which are of the De Laval type, are to be direct connected to motors. The foregoing equipment is all new. The complete installation includes the following pumps from the old plant: Two 8-inch domestic service pumps, with unit capacity of 850 imperial gallons at a pressure of 70 to 80 pounds; one 8-inch fire service pump, with a capacity of 850 pounds at a pressure of 120 pounds; one Holly steam pump, with a capacity of 1,500 gallons at 120 pounds pressure. The function of the booster pump is to by-pass the combined discharge of the domestic service pumps at time of fire and thus increase the usual service pressure of 70 pounds to the 120 pounds required for fire service. It can be promptly placed in service without requiring the shutting down of other pumps or otherwise affecting the normal operation of the station.

Coagulation Basins.

In building the coagulation basins the contractors had to relocate the old 20-inch force main and rearrange the existing pipes and connections and at the same time not to seriously interrupt the supply of water. Therefore, in order to secure continuity of service one of the existing centrifugal pumps was removed to an old pumping station, where it was used as a standby.

The coagulation basins are two in number, each being 32 x 66 x 18 feet, and divided by a concrete wall. The water is treated by sulphate of alumina. The two tanks containing the solution are situated in the chemical room, in the head house. Each tank is equipped with dissolving grids, agitators driven by an electrical motor, and piping to a drain leading to an outside sewer. Depth gauges show the amount of solution passing from the tanks to the orifice feed tanks. The clamps of the agitators and all bearings and valves are of acid bronze.

Two orifice feed tanks, made of cast iron, enamel lined, are installed. These are provided with float valve for maintaining a constant level of solution in the tanks. Two constant head tanks are so cross connected with the orifice feed tanks as to ensure that the discharge from either orifice feed tank can be run into either constant head tank. The latter tanks are of cast iron, enamel lined.

From the coagulation basins the water flows by gravity into the filter beds, four in number (one of which is reserved for future extension), and afterwards into the clear water basins situated below the filter units. Each filter is 19 x 25 x 9 feet, and is equipped with a strainer and air system, the filtered water and compressed air for washing being applied as follows: The filtered water at the rate of 8 1/3 imperial gallons

Reinforcing steel on coagulation basin.

per minute per square foot of sand surface, and the air at the rate of four cubic feet of free air per minute. Each filter is also provided with longitudinal wash water gutters, made of cast iron, finished so that the top edges of all gutters are on the same level. Venturi filter rate controllers are installed.

The filter material consists of gravel to a depth of 15 inches, made up of four layers of different grading and size, varying from pieces passing through a screen with 1 1/4-inch square openings to a screen with 3/16-inch square openings. It is specified that the sand must have an effective size of not less than .35 m.m. and not more than .55 m.m., and a uniformity co-efficient of not more than 1.75. The sand is laid to a depth of 30 inches.

The operating tables in the operating gallery (48 x 14 ft.) are of marble, and are provided with controlling handles and four-way valves for controlling the six hydraulic valves. The loss of head gauges, one on each table, indicate the depth of water in the filter and the loss of head in the filter, the latter being made known by an electrical attachment sounding an alarm. Two indicating and recording depth gauges give the water level in the filtered water reservoir and the elevation of the water in the coagulating basins.

After the water is filtered it is pumped into the domestic service pipe, or, when occasion requires, into a 14-inch main for washing the beds.

In addition to the filtration process, Wallace & Tiernan liquid chlorine apparatus has been installed for controlling and measuring the flow of chlorine. Two independent connections with the 24-inch suction pipe supplying the domestic service pumps have been made. One connection is located close to each of the 24-inch suction valves controlling this suction line, so that the chlorine is introduced into the suction line before it reaches the first pump suction, whether the flow of water be from the filtered water reservoir or directly from the river.

The mechanical equipment of the plant was supplied by the Roberts Filtration Manufacturing Company, Darby, Pa., represented by Arsenault & Plamondon, Ltd. The sub-contracts were: Roofing, Daniel & St. Jean, St. Hyacinthe; plumbing and heating, Blondin & Co., St. Hyacinthe; architectural iron work, John Watson & Sons, Ltd., Montreal; motors, Canadian Westinghouse Company, Hamilton, Ont.; electrical lighting, E. Lyonais, Montreal.

Will Require Year to Complete

Though completed, there is still sufficient work in connection with the Quebec bridge to engage the attention of Lieut.-Col. C. N. Monsarrat, chairman and chief engineer of the board of engineers, for at least another year. This was announced in parliament recently by Hon. J. D. Reid, Minister of Railways and Canals, who also paid high tribute to the services rendered by Col. Monsarrrat in connection with the big bridge.

Discussing the fuel situation apart from immediate necessity, before the recent professional meeting of the Canadian Society of Civil Engineers in Toronto, Mr. W. A. McLean, Deputy Minister of Highways for Ontario, pointed out that our coal and peat resources are exhaustible—all mineral resources are exhaustible. The production of timber, however, is continuous, and it is for the forestry expert to regulate consumption to the supply of timber in such a manner that from 27 to 30 per cent. of our lands will be in a wooded condition.

Engineers' Club Smoker

A smoker and auction sale of periodicals was held at the Engineers' Club on the evening of Thursday, April 11, at 8 o'clock. The feature of the evening was an address by Lieut.-Col. McKendrick, the well-known road builder, who has just returned from France. Col. McKendrick spoke in a very interesting manner on some of his experiences at the front. A fine musical program was also provided.

Manufacture of Ordnance

The fourth meeting of the Ottawa branch of the Canadian Society of Civil Engineers for the year was held on the evening of April 11 in the Carnegie Library. The speaker was Lieut. Edgar A. Jamieson, A.M.Can.Soc.C.E., inspector of guns and steel, who gave an interesting address on "The Manufacture of Ordnance." Lieut. Jamieson spent some months amongst the large ordnance manufacturing firms in Great Britain, and he described the various processes employed, from the manufacture of steel to the finished and proved gun. The paper was fully illustrated by a series of specially prepared lantern slides.

May Erect Natatorium at Vancouver

If plans which are under consideration are fully realized, Vancouverites and visitors are going to have ocean bathing throughout the entire year, under comfortable circumstances, within the next twelve months. According to the proposal, the cost of the building and equipment will be in the neighborhood of $50,000. This amount is to be raised by having representatives of the Park Board, City Council, Board of Trade, Rotary Club, Y.M.C.A., and other athletic and public organizations solicit subscriptions from $25 up, these to be ultimately paid back, with interest at 7 per cent. Should the park commissioners endorse the scheme, an engineer will be sent to coast cities to gather the latest ideas in construction.

Ship Supplies Enter B. C. Free

As soon as Chief Customs Inspector Busby arrives in Vancouver from Ottawa in the near future it is the intention of the wholesale bureau of the Board of Trade to enter into a general discussion with him on customs duties, especially with regard to the alleged unfair advantage of American dealers over the local wholesalers with regard to supplies for British Columbia shipbuilding yards. It will be pointed out that in Vancouver there are stocks on which 37 per cent. duty had been paid. This is a handicap prohibiting competition with United States firms. Under the present system these concerns are allowed to sell supplies for the construction of Imperial Munitions Board ships free of duty, in this way being enabled to successfully compete against British Columbia firms who have had to pay duty, taxes, etc., on stocks purchased prior to removal of the duty.

Mr. Edgar M. McDougall, of Montreal, president of the Canada Iron Foundries, Ltd., died in Los Angeles, Cal., on April 4th, in the presence of Mrs. McDougall and Major E. G. M. Cape. He was 48 years of age, and was the son of the late Mr. John McDougall, founder of the Caledonia Iron Works. The late Mr. McDougall was identified for many years with the iron and steel business in Montreal.

Top view of concrete bridge at Grand'Mere, P.Q.

View from below of concrete bridge at Grand'Mere, P.Q.

Concrete Bridge at Grand'Mere, Que.

Erection of 40-ft. Girders and Slabs Over the Walsh River

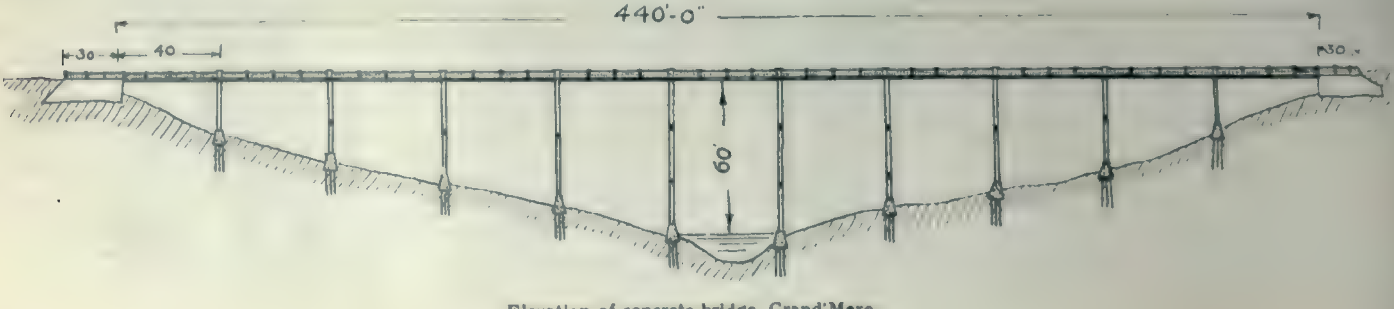
THE Walsh River passes a few hundred feet west of Grand'Mere, and discharges in the River St. Maurice. It is on the Royal Road between Grand'Mere and Ste. Flore, the outlet to all the northern parishes on the western side of the River St. Maurice.

Some twenty years ago a wooden trestle was built by the municipality and on account of the expensive repairs required every year, the city of Grand'Mere decided to rebuild it. In 1916 they retained the services of Mr. Charles Gelinas, civil engineer, for the preparation of a plan showing the best way to renew it. The engineer suggested reinforced concrete and submitted a scheme showing a ten span concrete bridge on reinforced concrete square columns. The project was accepted and Mr. L. A. Beauchemin, general contractor, Montreal and Grand'Mere, signed a contract with the municipality for its execution.

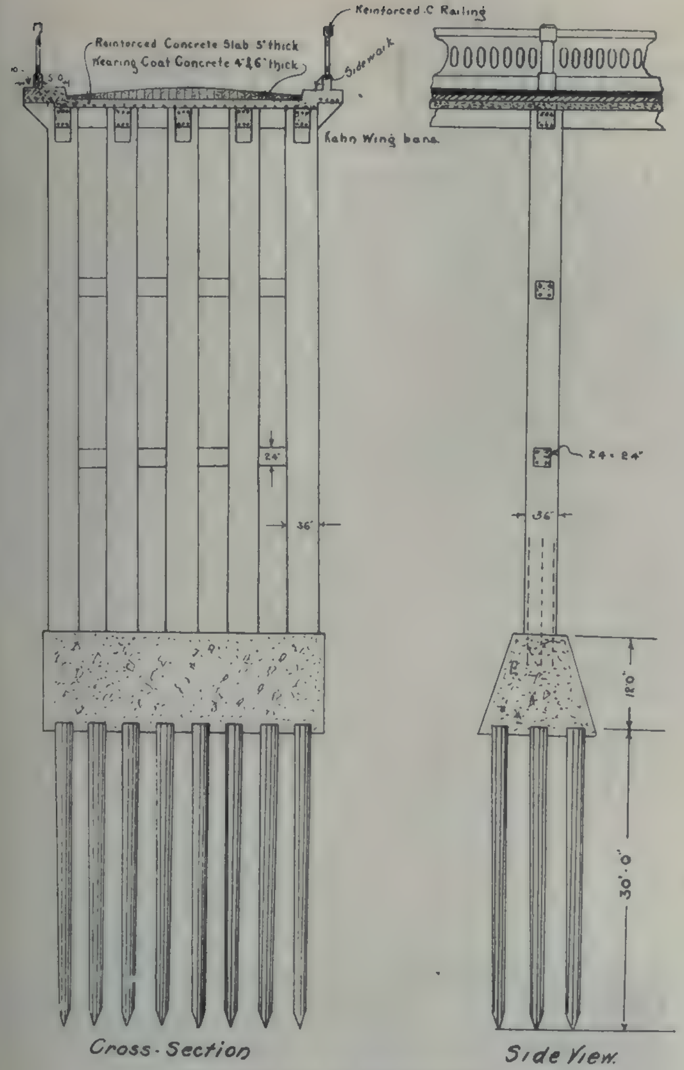
The bed of the River Walsh is composed of soft clay and foundations were designed, using straight wooden piles, 30 feet in length, and 10 inches in diameter at the smallest end. Twenty-four piles were sunk under each pier—eight lengthwise and three crosswise. These piles were sunk by means of a steam pile driver. The tops of the piles were sawn at different elevations, depending upon the slope of the river.

Plain concrete piers were built over each pile foundation with a 10-foot width at the bottom and 5 feet at the top. The foundations were twelve feet high and 28 feet long. Each pier contained 93.33 cubic yards of concrete. The distance between the piers is forty feet centre to centre, and each pier supports a series of square reinforced concrete columns, thirty-six inches in diameter. The shape of the columns was made uniform in order to facilitate construction and economize in the use of the forms. From the bottom to the top of each column run eight 1¼-inch steel rib bars, tied together by ⅜-inch steel bars spaced twelve inches centre to centre. The columns are five in number on each pier and they are bound together by reinforced concrete tie beams, 24 inches square. The number of tie beams used depends on the height of the columns, the highest being fifty feet with three tie beams, each one reinforced by four 1¼-inch rib bars running the full length of the beam, 26 feet. In the beam connected to the slabs there are six rib bars. From each row of columns run five longitudinal concrete girders, 24 in. x 18 in. x 40 ft. They are reinforced with Kahn wing bars.

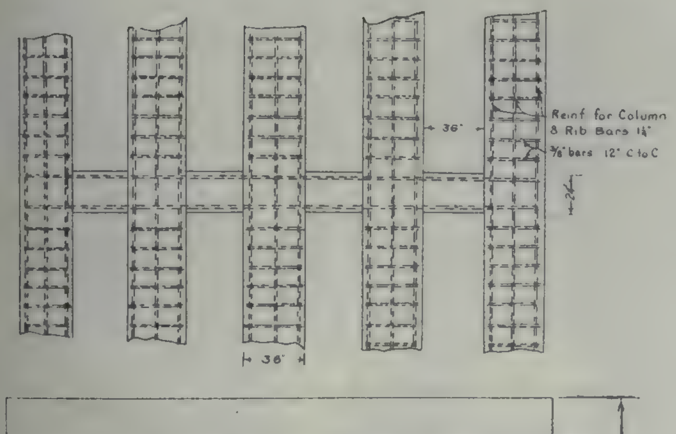
Five-inch reinforced concrete slabs were used on the girders. Their reinforcing consists of ½-inch steel bars placed six inches centre to centre cross-



Elevation of concrete bridge, Grand'Mere.



Piers were built on pile foundation.

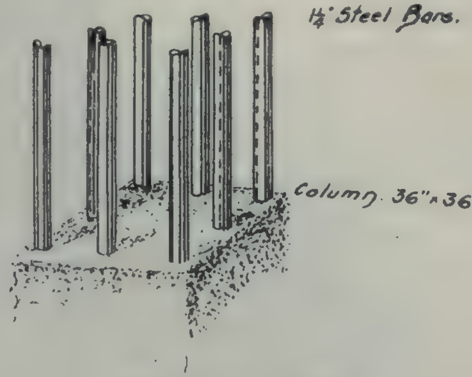


Details of tie-beam and columns.

wise, and twelve inches centre to centre lengthwise.

The roadway is 18 feet wide and consists of concrete six inches thick with a crown of 2 inches at the centre. A five-foot sidewalk is provided on each side of the roadway. A reinforced concrete railing was moulded outside of the work and brought in place. The panel sections were ten feet in length. During the spring, electric lamps will be placed on this railing to light the bridge.

The total length of the bridge, including the abutments, is 440 feet. The total cost was $45,000. 15,000 feet b.m. of 2-inch planed spruce lumber were used in the forms. The cost of piles was approximately 90 cents per lineal foot sunk. The side railings when in place cost $5,600. 2,200 cubic yards of plain and reinforced concrete were set in the forms. The unit cost was, for the plain concrete, approximately $7 per cubic yard, and for the reinforced concrete $22.



Reinforcement of columns.

The work was directed by Mr. G. A. Gruninger, the contractor's engineer, of Three Rivers.

How Can "Industrial Railway" Cars Be Dumped Clean When Discharging at the Track Level?

The small (1½-yard) V-shaped bodies of "industrial railway" cars do not completely discharge their loads when dumped onto the ground at the level of the track. The material flows out into a pile that backs up and chokes off the complete discharge of the load. This is a serious enough difficulty to make it necessary to employ three shovelers to clear the cars where as much as 250 cubic yards of sand and gravel are delivered daily into the loading skip of a concrete mixer on road work. Engineering and Contracting suggests the following solution of the problem:

Lay a strip of canvas across the bottom of each car and up the sides. Fasten one end of the canvas to the upper edge of the car, on the side that is to descend when dumping. Fasten a heavy cleat to the other or free end of the canvas, with a ring in the cleat. After dumping the car, the dumpman hooks a rope to this ring, and the engineman winds in on the rope, which passes through the snatch-blocks and around the winch head of the engine. This draws all the material out of the car. Whereupon, the strip of canvas is thrown back across the bottom and sides of the car ready for the next load.

The National Brick Company of Laprairie, Ltd., have removed their offices from Victoria Square to the Drummond Building, St. Catherine Street West, Montreal.

Steam and Gas Tractors for Farm Work

Greatly Increasing Production in Britain—Industry Only in Its Infancy in Canada

THE rapid development of tractors has largely been brought about by the enemy submarine activity. Farming the world over is undergoing a revolution. Farmers are required by their respective governments to increase the acreage under crop, and must accomplish this with much less manual labor than they formerly employed. This labor shortage and the enormous demand for agricultural products, leaving out the fact that every patriotic person is doing his utmost to conserve and produce food, merit the outlay of considerable money on the mechanical devices for tilling the soil.

As a class, farmers were very slow to adopt the motor-driven vehicle as a mode of conveyance. Now they use it extensively, for they find it is the means of saving much time and labor in transporting their produce to the market. The application of self-propulsion to machines destined to operate on the land involves more difficulties than are met with in designing a machine to operate on good road surfaces. For many years the only method for mechanical plowing was by cable haulage. In this case the motive power is in a stationary unit, placed at the end of the field. The plow is drawn by a cable running through snatch-blocks and wound on the drum of the engine. A great deal of time was lost in arranging the snatch-blocks, and the outlay for machinery plant was, in most cases, out of the question. The alternative, now being developed at a remarkable pace, is direct haulage by a tractor propelled by steam or internal combustion engines or electricity. There will be great opportunities in after-the-war times for the application, in more ways than one, of electrical energy for tilling the land, but at present we are only concerned with steam or motor engines.

The problem that at present requires considerable attention, and is still a matter of speculation, is whether a universal machine or a special machine is the more economical. It is no easy matter to construct a machine that is adapted equally as well to stationary work, to operating on the land, and to road haulage purposes. One of the principal objections raised by farmers to direct traction plowing is that the tractor compresses the earth and thereby reduces croppage. This objection was largely overcome by making the tractor wheels with a wide tread and having the front wheels run in a different track. To meet conditions where ordinary wheels cannot be made to answer on the land, and for use under any circumstances, the chain track or caterpillar type of tractors is being manufactured in large numbers. The haulage of war materials in the Old Country and the effectiveness of the "tanks" on the western front has emphasized the practicability of this method of propulsion. It is said that the chain tracks add mechanical complications that are beyond an ordinary farm hand's ability to master, and that the friction losses are high and the running efficiency very low. Whether the advantage of spreading the weight over a larger area compensates for the mechanical difficulties arising from the chain track drive has still to be proven.

Agricultural tractors may be roughly divided into two classes—those which are propelled by steam and those which are propelled by internal combustion engines. Steam tractors follow the form taken by road rollers, but are considerably lighter, since weight is an important factor. The accompanying illustration shows a steam tractor of the larger type. This machine, known as the Foster tractor and manufactured in England, has its advantages in the fact that it is very powerful and is capable of handling a large number of gang-plows. This machine was built especially for countries like the Canadian West and Argentine Republic, where straw and other vegetable refuse is used as fuel. In addition to direct plowing, the engine is designed to run a 5 ft. 6 in. threshing machine at its full capacity, and is capable of hauling such a thresher, together with sleeping-van and water cart across country. The fly-wheel is arranged with a balanced friction clutch inside the rim, which is used to back the engine away from a threshing machine, without it being necessary to stop the work or remove the belt. This ability to tighten the belt is particularly valuable in varying temperatures where belts stretch considerably. The general specifications of the engine are as follows:

Foster tractor hauling 21-disc plough.

Continuous economical horse-power	37
Continuous maximum horse-power	45
Emergency maximum horse-power	52
Diameter of cylinder	9½ in.
Length of stroke	12 in.
Diameter of fly-wheel	4 ft.
Width of fly-wheel	10 in.
Revolutions per minute (governing)	180 and 200
Diameter of driving wheels	6 ft. 6 in.
Standard width of driving wheels	2 ft. 6 in.
Speed, miles per hour	3
Extreme length of engine	19 ft. 6 in.
Height to top of fly-wheel	9 ft. 6 in.
Extreme width of engine	9 ft. 8 in.
Weight empty, tons	11
Weight, full, in working order, tons	12¼

Tractors Propelled by Internal Combustion Engines

In the case of oil or gas engines, the designer has a large field, and is able to evolve types of his own. A study of the various machines on the market shows that the engineer availed himself of this opportunity. Some have four wheels, some three, still others have only two wheels, depending on a wheel attached to the plow or vehicle it may be drawing for further support. Finally, there is the motor-driven caterpillar tractor.

which, it is believed, is destined for far greater development than is at present the case. Nearly all the earlier types of motor-driven tractors had the same fault in not having a reserve of power to cope with emergencies. The designers, failing to recognize that while a horse-power in an engine is the ability to generate so much constant energy, it is often necessary for short periods to provide for overload. It has been determined that it requires 6 to 10 h.p. to plow a single furrow at the rate of three miles per hour, depending on the nature of the soil, and general practice now is to equip the tractors with a 30 to 35 h.p. engine and recommend the use of a three-furrow plow.

Two illustrations of a chain track type of agricultural tractor are shown. In Fig. 2 the machine is shown being operated by a woman and hauling a three-disk plow. In Fig. 3 the same machine is shown operating a threshing machine. The engine is a four-cycle, four-cylinder type, equipped with a special vaporizer for dealing with oil and paraffin. It has two forward and one reverse speed, the control mechanism being actuated by a straight through lever. The clutch is operated by a fabric to metal cone, controlled by a foot lever.

Steel Shoes and Links for Chain Tracks

The chain tracks have received a good deal of attention. They are made up of pressed steel shoes and pressed steel links, the former having specially shaped gripping excrescences, which are worthy of note. The pins joining the shoes and links together are first turned, then hardened and ground. The weight of the vehicle is carried at each side on four rollers, interposed between the underside of the frame and the chain tracks. At the top, between the sprocket wheels, the tracks are guided by means of two guide rollers. Means are provided for adjusting the length of the chain tracks when necessary. The tracks are arranged to lift independently from the back axle, and are connected together at the front end by means of the axle and equalizing levers, so as to enable the tractor to operate on rough ground without any undue stresses being set up.

Tractor supplies power for threshing.

Steering is effected by releasing the clutch of one of the chain tracks and driving through the other. A brake is fitted to the outer casing of each cone clutch. Each brake is independently operated by means of a foot pedal, and can thus be utilized to lock one chain track when the other is being revolved, so as to turn the vehicle. The control levers, change speed levers, and switch are all fixed in such positions that they are readily accessible from the driver's seat.

The draw-bar is arranged to pull from a point near the centre of the machine, and to swing horizontally, so as to ensure that the pull shall always be taken in a direct line. The draw-bar pull is, we are informed, two tons in slow gear. For the driving of machinery there is a belt pulley. One of the illustrations represents the tractors being used for driving a threshing machine. The weight of the tractor on the road is 6,400 pounds. The total length is 11 ft., the total width 5 ft. 4 in., and the extreme height 5 ft. 6 in.

Chain-wheel tractor ploughing.

The whole world will take a long time to recover from the devastating upheaval to which it is at present being subjected, but it would take much longer to establish normal conditions were it not that mechanical methods of performing work will be employed to a greater extent than has hitherto been the case.

Vancouver and outside capitalists are said to be preparing to erect a small smelter for the production of pig iron. The syndicate holds claims on the ore deposited at Fanny Bay, 120 miles up the coast, formerly owned by David McCallum. The claims have recently been sold for a reported price of $60,000. The deposits are already being worked, showing well in magnetite and hematite iron ore. The claims are located on a slope within 2,000 feet of tidewater, where excellent shipping facilities are at hand. The company intends to erect a plant capable of handling ten tons daily, and work is to be started in the near future. Arrangements have been completed for the disposal of all the pig iron the plant can turn out, and in view of the present shipbuilding activities on the coast, a further expansion is confidently looked for by the company.

Desert Reclamation

England is already planning to reclaim the deserts of Mesopotamia by irrigation on so grand a scale as to dwarf everything of the kind hitherto conceived. When the project is completed half the present population of the British Isles could be supported on the reclaimed lands. The work will involve extensive harbor development and railway construction.

Kettle Rapids Bridge, Nelson River

The Present End of Steel on the Hudson Bay Railway System—Continuous Structure 1000 Feet Long

ONE of the most interesting papers recently presented before the Canadian Society of Civil Engineers was that by W. Chase Thompson, Consulting Engineer, Montreal, before the Montreal branch, on Thursday, April 11, describing the Kettle Rapids Bridge. This is a bridge spanning the Nelson River at a point about 332 miles north of The Pas, Man. It was described in some detail in the issue of the Contract Record of February 27, 1918, by Mr. Sterling Johnson, assistant manager of construction, Canadian Bridge Company. Further information submitted by Mr. Thompson in his paper, not contained in Mr. Johnson's article, is given below:

There are three important bridges on the line: The first crosses the Saskatchewan River at The Pas, and comprises four fixed-spans of about 150 feet each together with a swing span of about 250 feet; the second crosses the Nelson River at Manitou Rapids, mile 242, and is a handsome structure of conventional deck cantilever type, with a channel span of 304 feet 6 inches and anchor spans of 108 feet 9 inches, supplemented by an 85-foot plate-girder span at the north end; the third, which is the subject of this paper, is at the second crossing of the Nelson River, or Kettle Rapids, mile 332, the present end of steel.

Choice of Three Types of Bridges

Three types of bridges were practicable for this location; first, simple spans, with temporary members over the piers for cantilever erection of the channel span; second, the conventional cantilever bridge, with a central freely-suspended span; third, a true continuous-girder bridge. The first would have been satisfactory, but un-economical, owing to the great weight of extra metal required for erection stresses only. The second was rejected partly on account of the objectionable articulated joints at the ends of the suspended spans, but principally because of the expensive shop and erection work in connection therewith; for an economically-designed cantilever structure would have required a much greater depth over the piers, with considerably less depth at the abutments and for the suspended span, resulting in sloping chords and irregular webbing; besides, in order to obtain such economical proportions, it would have been necessary to locate the bottom chords as close to the base of rail as possible, thus largely increasing the quantity of concrete in the substructure.

The third type, as designed and built, is the most rigid of all, and the most economical; for it required no extra metal for erection stresses, except in the bottom chords of the channel span adjacent to the piers, where the increase of section was slight; the simplicity and uniformity of the framing reduced the cost of fabrication to a minimum; and the continuous horizontal chords, without adjustable joints, greatly facilitated the work of erection. It is admitted that continuous-girder bridges have been regarded unfavorably in the past; for it has been claimed that the usual theory for computing the stresses therein, which assumes a constant moment of inertia, is inexact; that the computation of the stresses is too difficult and tedious; finally, that the least settlement of any support would radically alter the stresses and thus endanger the structure. No doubt, in the old days of pin-connected bridges, continuous girders were undesirable in many respects; although a notable example of such a structure, which has received much praise and which gave excellent service for many years, was the old Canadian Pacific Railway bridge at Lachine. Now that pin-connections have been almost entirely superseded by riveted joints, continuous girders are growing in favor; and the most remarkable example of such construction is to be found in the recently-constructed Sciotoville Bridge over the Ohio River, comprising two continuous spans of 775 feet each.

Regarding the objection, that the computed stresses are inexact, it may be stated that, in the present instance, the reactions were first computed for the panel concentrations by formulae as given in Merriman and Jacoby's "Roofs and Bridges," part IV., pp. 12 and 13, and afterwards checked by the elastic method. The difference in the results obtained by these two methods was less than one-half of one per cent., which should satisfy the most exacting. This close agreement was undoubtedly due to the parallel chords and nearly constant moment of inertia; but, in the most extreme case, the error due to the use of the formulae would probably not exceed 6 per cent.

The objection, that the labor of computing the stresses for continuous girders is too difficult and tedious, is unworthy of notice, especially where a large and important structure is concerned.

Finally, the claim with reference to results that would be produced by a possible settlement of one or more of the supports, is more rational, but much exaggerated; for continuous girders are very elastic structures, and can accommodate themselves to small settlements of supports without developing serious alterations of stress in their members. In this case, the ends of the trusses, if unsupported, would deflect 25 inches below the horizontal line from dead-load; and the alteration in the dead-load reactions at the abutments due to raising or lowering the end supports a whole inch would only be 9,500 lbs., or 4 per cent., whilst the reactions and stresses for the live-load would not be affected at all. Moreover, it is inconceivable that any settlement of the foundations can take place, as they are all on the solid rock; otherwise, this design would not have been adopted. Furthermore, in order to provide for possible small inaccuracies in fabrication or erection, the ends were made adjustable by allowing 1⅝ inches for shims between the shoe-castings and the bottom chords; and hydraulic jacks, with gauges attached, were used to set the ends at the height necessary to obtain the computed dead-load reaction. In this connection, and referring again to the Sciotoville Bridge, the following quotations from an article by Clyde B. Pyle, published in Engineering News-Record, January 31, 1918, will be of interest:

"One of the most striking features of the entire erection was the curve for the last few inches of the jacking, after the steel towers were both free. The computed increment for each inch of lift was 7.5 tons; and the actual increase in load was too small to be read on the gauges.

"It is quite evident from this condition that, for long-span continuous trusses, it is not as vital a point as was formerly thought to be the case to have the supports at exactly correct elevations. In this case an error in setting one of the end supports, say as much as 3 inches, would have changed the end reaction 22.5 tons, or the stress in the end post 32 tons, which would be less than the probable error in computing the actual stress in that member. The worst condition of shop-work, erection and setting of shoes could not possibly total more than one inch; so that the certainty of stresses and therefore the safety of such a bridge is left without question.

"The fact that complications enter into the design and erection cannot bar the use of such bridges as long as they are economical. The reasons usually given, that the stresses are not statically determinate and that uncertainties of stresses result from slight errors in elevation of the supports, are no longer valid."

Details of Design

The structure has been designed in accordance with the General Specifications for Steel Bridges, issued by the Department of Railways and Canals in 1908, except for a slight modification in the impact formula, affecting alternating stresses only, and a change in the allowable unit stresses for compression members.

In the matter of impact, when dealing with alternate live-load stresses, the Department's specification requires the impact to be computed by squaring the arithmetical sum of the tension and compression stresses due to the live load (or the range of stress), and dividing by the maximum algebraic sum of coexisting dead load and live load stresses, or

$$I = \frac{\text{range}^2}{\text{max.}},$$

Now, taking an extreme case in which a member is subject to alternating live-load stresses of equal amounts, but no dead-load stress, the impact would be

$$\frac{(L + L)^2}{L} = 4L,$$

or four times the live-load stress of either kind, which is certainly excessive. If, however, we take for the range the live-load stress of one kind and add to it 4/10 of that of the other kind, we have

$$\frac{(L + 0.4L)^2}{L} = 2L,$$

approximately, or an impact equal to twice the live-load stress of either kind. which would seem to be ample. In conformity to the above argument, impact has been computed by the formula,

$$I = \frac{\text{range}^2}{\text{max.}}$$

with the arbitrary stipulation that the range shall be taken as the arithmetical sum of the live-load stress of the greater kind and 4/10 of that of the lesser. When the live-load stress is of one kind only, the formula reduces to

$$I = \frac{L^2}{L + D},$$

in which L = live-load stress and D = dead-load stress.

Concerning the unit-stresses for compression members, the Department's specification calls for 16,000 lbs. per square inch reduced by Gordon's formula, using in the denominator the factor 18,000 for square ends, 12,000 for one square and one pin end, and 9,000 for pin ends. It is now quite generally recognized, however, that 16,000 lbs. per square inch is entirely too high for short columns; and the Joint Committee on Columns and Struts in the United States, which has recently submitted its final report, recommends a maximum working unit stress of 12,000 lbs. per square inch, which is therein shown to provide a factor of safety of 2, or the same as for tension members when designed for a unit stress of 16,000 lbs. per square inch on the net section. In the General Specification for Steel Highway Bridges, recently adopted by the Society, the formula for compression members is $12{,}000 - 0.3\,(l/r)^2$, which becomes zero when $l/r = 200$. In this bridge, the compression members have been designed in accordance with the formula,

Abutment No. 1 under construction.

$$12000/1 + \frac{(l/r)^2}{36000}$$

which agrees closely with that adopted by the Society for values of l/r up to 70, but gives somewhat higher unit stresses for greater working ratios.

The total estimated weight of steel in the structure (including floor bolts), computed from the writer's detail drawings before the contract had been awarded, was 4,424,000 lbs.; and the actual shipping weight, as determined by the scales, was 4,415,000 lbs.

Substructure

The substructure is of concrete throughout, composed of pit gravel and cement, in such proportions as were found by trial to give the best results. It had been intended to construct at least the abutment and pier on the southern side of the river during the autumn of 1916; but the track did not reach the bridge site until the end of October; cold weather set in shortly after, and there was barely time to construct the foundation for abutment 1. Excavation for this foundation was carried to a depth of over 10 feet, through frozen clay and silt, to the solid rock. The concrete was placed during the second week in December, and in very cold weather; but the materials had been heated, the mass was large and the result was entirely satisfactory; as found from a careful inspection the following spring. The abutment was completed during the month of April, 1917.

Operations at pier 2 were begun on April 10th, and under very adverse circumstances; for the river was then at elevation 328.0, or 10 feet above the average rock surface at this point; and the rock was covered with a solid mass of ice, 25 feet thick. However, it was necessary to get ahead with the work as rapidly as possible; so the ice was excavated, and the rock was bared by May 5th, at which date the water had fallen to elevation 325.0. Although the ice walls of the excavated shaft appeared to be perfectly solid throughout, the water percolated through and stood at the same elevation as that in the open river channel; but it was perfectly still, without current or surge. A timber caisson, conforming on the bottom to the irregularities of the rock surface, was then constructed; and all small openings therein were sealed by sheet piling, carefully scribed and driven so as to broom the ends thereof. Every inch of the rock surface inside of the caisson was then picked with needle bars, to insure that it was entirely clear of ice; and heated concrete was deposited by deep-sea buckets. The rock surface at this pier had previously been carefully examined during low water, and found to be absolutely sound; thus every confidence may be placed in the foundation. The footing for this pier was completed on May 9th; the construction of the main shaft thereof offered no difficulties, and was effected without incident.

At pier 3, no difficulties incident to water or ice were encountered; for work at this point was not started until June 29th; but there was a horizontal fissure in the rock at about elevation 322.0, which necessitated blowing up by dynamite the overlying mass. This resulted in giving an entirely satisfactory though very irregular foundation, to which the footing for the pier was made to conform.

Excavation for abutment 4 was commenced on June 14th, and was carried through about 10 feet of frozen clay, silt and boulders to the solid rock. The footing, up to elevation 341.5, was completed July 21st.

The pit gravel, used throughout on this work, was invariably frozen and required to be thawed by steam; thus all of the concrete was placed warm, and with most gratifying results; for, on removal of the forms, not a single bad spot was discovered.

The butterfly wing walls of the abutments were reinforced by twisted steel rods, one inch square, placed 3 inches from the rear surface. There were horizontals, 6 inches apart, wired to verticals, 3 feet apart. In addition, two such rods were placed along the upper edge of the wings.

The total quantity of concrete in the work is about 3,000 cubic yards; and, of reinforcing steel in the wing walls, 2,300 lbs.

General

The laying out of the work was difficult and tedious, owing to the irregularity of the ground and to the necessity of locating pier 3 by triangulation; but the instrument work was done with such care and precision that all important dimensions and distances were afterwards found to be practically exact. In locating the centre line of bed plates on pier 2, and that of the shoe castings on pier 3, where great accuracy was desired, the piano-wire method of measurement was used, taking into account the pull on the ends of the wire and the corresponding sag, as determined on a level surface, and making the proper correction for temperature. The distance between centres of bearings on piers 2 and 3 was afterwards found to agree with the steel structure, as built, within 5/16 inch. It had been specified that the centre line of the expansion shoes should coincide with that of the corresponding bed plates at a temperature of 30 degrees, Fahrenheit; and, on inspection, with the thermometer at zero, the centre line of the roller shoes at pier 2 was found to be exactly 1¼ inches northerly of the centre line of the bed plates, instead of 15/16 inch, the amount of contraction in the steel work in 400 feet for a fall in temperature of 30 degrees. Thus the distance between the bearings was too great by 5/16 inch. If there had been any appreciable error in the setting of the bearings on these piers, it could have been rectified, as provision had been made for jacking up the structure, if necessary; but, as the dead load reactions here are about 500 tons each, and the shoes very awkward to move, any such adjustment after erection would have been difficult and expensive.

The entire work has been under the general supervision of Mr. W. A. Bowden, Chief Engineer, Department of Railways and Canals, Ottawa; and of Mr. J. W. Porter, Chief Engineer, Hudson Bay Railway, The Pas. It was designed in full detail by the writer, who has been retained throughout for consultation in connection therewith. The superstructure was fabricated and erected by the Canadian Bridge Company, Ltd., Walkerville, Ont. Mr. T. B. Campbell, Bridge Engineer, Hudson Bay Railway, was in charge of the bridge site, under whose immediate supervision the concrete work was constructed, and by whom all lines and elevations for the erection of the steel work were given; Mr. I. E. Mahon was the Superintendent of Erection for the bridge company; and Mr. James Carr, representative of the Canadian Inspection and Testing Laboratories, Limited, attended to the field inspection. The entire work has been carried out without loss of life and without a serious accident.

Great credit is due to Messrs. McDonald Brothers, for the excellence of the concrete work; to Mr. Campbell, for the accuracy of his lines and elevations, and for his efficient supervision; to the engineers of the bridge company, for their splendidly conceived and carefully prepared scheme of erection; to the shops, for the neatness and accuracy of workmanship; finally, to Mr. Mahon, for his skill and care in handling under difficulties this important and somewhat unusual piece of erection work.

The first quarter of the year has not opened well for the Montreal building trade, judging by the civic permits. Last month the total was $241,660, a decrease of $101,800, while the value for the three months was $434,815, a decrease of $561,105. More work, however, is coming out, but is not of much importance. While it looks as if there will be a little activity in the construction of schools and churches, at the moment the outlook for heavy construction is not satisfactory. Montreal contractors, so far, have not been entrusted with so many out-of-town contracts as was the case in the two previous years, but they are hoping that the government office at Ottawa will come their way. Some three or four bids from Montreal firms are in. Prices of building supplies are higher, due in some degree to increased transportation charges and wages.

A company is being promoted for the construction of concrete vessels in Vancouver.

Motor Trucks and Highway Transportation

By Maurice B. Greenough*

THE latest report of the Bureau of Railway Economics for the Railroads' War Board shows loaded car in August, 1917, was 27.9, 2.6 tons that the number of tons of freight carried per more than for the corresponding period in 1916. For the same comparative months, the average trainload tonnage rose from 646 to 686. Again, for the month of August the average freight locomotive daily run increased from 68.8 in 1916 to 69.4 in 1917. In 1915 the daily average was slightly over 64 miles per day. The daily run of freight cars decreased between August, 1916-17 from 27.5 to 27.1 miles.

These figures represent the outcome of the railroads' endeavors to increase hauling efficiency. Excess car loading, more careful stowing of freight, sailing days for less than carload shipments, and other agencies all contributed. But examine the reports of unfilled car requisitions on the first of these months in 1917:

May	148,216
June	106,649
July	77,682
August	33,776
September	40,000
October	70,000
November	140,000

Compare the shortage of nearly 34,000 cars on August 1, the season of maximum car supply, with the situation on the 1st of August, 1915. There was then a surplus of 265,000 cars.

Excess Demand for Transportation Growing

Commenting on the car shortage of November 1, Railway Age Gazette says: "The conclusion is obvious. Increases in traffic are again occurring faster than increases in transportation efficiency. Under present conditions that means that the excess demand for transportation over the supply of it is growing."

Translating the car shortage of November 1 in terms of tonnage withheld from movement, there were approximately 3,906,000 tons of all commodities; 5,700 freight trains above the available supply were required.

These are the facts on railroad hauling capacity today. What of the future?

The best railroad officials expect, or even hope to do, in the coming year is to add enough new locomotives and freight cars to replace what is forced to be scrapped through entire lack of utility. If every carrier were able to pay spot cash for new equipment it could not be secured, and there is a threatening shortage in materials available for repair and maintenance of track and rolling stock. Four new locomotives were recently delivered to the Eastern division of the Pennsylvania Railroad, delivery on which was to have been last February. On the same division between 30 and 40 locomotives were thrown out of commission in the recent cold snap by frozen tubes. At a time when cars and engines are working more miles per day than ever before, approximately 10 per cent. less are awaiting repairs in the shop. According to the report of the chief inspector of locomotives to the Interstate Commerce Commission, there are 54.5 per cent. of locomotives in service that are defective, 7.5 per cent. more than a year ago.

Railway Age Gazette addresses itself to the question: "Have the railways reached, or are they closely approaching, the limit of their capacity with their present facilities?" It says:

Railroads Approach Limit of Capacity

"The railways as a whole are still increasing the amount of traffic they are handling; and nobody can compare the statistics of car capacity with those of the tons actually being hauled per loaded car, . . . or the comparative statistics of different roads, showing as they do that some roads are handling more business per mile of track and per mile of line than other roads under comparable conditions, without concluding that it is possible to handle a much greater tonnage with existing facilities. But what is possible and what is practicable are commonly two very different things; and this is obviously the case here. . . . All the evidence indicates that, under existing conditions, the railways are approaching the limit of what is practicable for them to do."

On November 15 the Railroads' War Board issued Bulletin 42 to all railroads, containing 14 suggestions for expediting transportation and relieving shortages, the eleventh of which read:

"Encourage the use of motor trucks and trolley lines for handling short-haul freight."

This statement at once disposes of the claim that motor truck transportation will injure the railroads by competition. Motor trucks for short hauls merely relieve the railways of that portion of their business which most reduces their effectiveness in moving carload shipments of long-haul commodities, which is productive of terminal congestion, and from which they derive the least revenue. The railroads are doing their utmost to keep freight moving, but the volume is too great. But they realize the vital necessity that the relief measures be found, because they know that upon transportation rests the major burden of war preparations and military maintenance. The problem is squarely placed before the public to provide the relief.

Highway Transportation as a Means of Relief

We have the highways in better or worse condition for this service, but, whatever their condition, we should make it a guiding principle to ship nothing by railway that can possibly be sent over the highway. Approximately 50 per cent. of present freight traffic is now directly connected with war maintenance, and within the coming year it is expected that this amount will rise to 75 per cent. W. A. Alsdorf, secretary of the Ohio Good Roads Federation, recently said: "If the war is not won in six months virtually every private shipper will be forced to send his freight over the highway."

Let the Cleveland-Akron highway in Ohio serve as an example of short-haul relief. In a recent 72-hour traffic survey 504 trucks were observed in 32 hours. Twenty-eight different commodities were recorded, aggregating 890 tons. If freight cars had been used, 32 would have been required. But relief was afforded equivalent to despatching one car an hour alternately from Cleveland to Akron and from Akron to Cleveland. This traffic also was entirely spontaneous; it was entirely without any encouragement to make use of the advantage other than the potential opportunity.

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A motor truck traffic of 16 vehicles an hour is far below the capacity of a substantial highway. If the traffic were to be at the rate of one vehicle a minute, there can be transported, between 6 a.m. and 10 p.m., 7,200 tons of freight between Akron and Cleveland.

For every 30 days there is, then, relief at the rate of 315 trainloads, the equivalent of five trains a day each way.

To build an enduring commercial highway between two cities 50 miles apart requires the loan of 5,000 single freight car trips if all the materials for the road are imported. This assumes a monolithic brick highway 18 feet wide, 4-inch brick laid on 4-inch concrete, without curbing. After the road is built the original loan of cars is repaid in relief in 35 days, and for every 30 days thereafter, on the truck-a-minute basis, the same 315 trainloads can be shipped. Reproduce these illustrations in general application throughout the country and transportation shortage is a thing of the past.

Highway Engineer's Field Widened

Daily reports are forthcoming of new enterprises making use of highways for commercial transportation. The highway engineer is seeing his functions expanded from merely those of a technical capacity in design and construction to a new field wherein he becomes a highway transportation engineer. In his new relation the element of traffic becomes more significant. The factor of economic service is introduced.

The value of traffic censuses as measuring conditions at the moment and affording a basis for estimating future traffic is widely expounded. There is, however, little beyond a general value in the theory. There is no accurate basis of correlating the results of traffic surveys and the type of improvement actually to be chosen. Thus we find not less than five or six different types of surfacing on one road bearing the same character of traffic throughout its length. A theory which brings such a diversitv of results can have little of scientific merit to recommend it.

The commercial use of highways forces a readjustment in our views of traffic itself. Counting and classfying traffic means little in itself. The weight of vehicles becomes paramount. Heretofore practical recognition of vehicular weights has come from legislative rather than from scientific bodies. Nearly all laws restricting weights, however, have had the effect of denying the use of highways to a character of service that the present transportation predicament of the country renders essential to be encouraged. The basis of this legislative restriction seems to be that type of road improvement which is cut into and rutted by heavy traffic—traffic that represents a practical carrying unit.

Those types which are structurally incapable of becoming rutted or broken up are placed in the same class by the law. The situation is exactly analogous to what would obtain if railroad engine and car weights were to be restricted to the load-bearing capacity of rails 60 pounds to the yard laid in a cinder ballast, when there are thousands of miles of railroad line built of 120-pound rails, rock ballasted, that are particularly intended for the heaviest rolling stock.

Railroad engineers, by practice, have demonstrated that they have a clearer grasp of what is meant by building a road to meet the traffic than have highway engineers. They know the economy of hauling in the larger units, and so they correspondingly increase the strength of their roadbeds and bridges to accommodate more economical hauling.

Classification of Highways According to Capacity

Under the new conception a highway represents a potential transportation asset belonging to the public. There should, then, be a concerted move on the part of the public and its officials to encourage the use of the road up to the limit of its capacity. In other words, we must "dig up the business for our roads," and adjust our viewpoint of their functions to this attitude. Our highways will then be classified as one-ton roads, three-ton roads, or five-ton roads, and a uniform system of regulation adopted which encourages, not discourages, use.

At the outset of applying this program there are thousands of roads whose capacity of commercial transportation is limited by the particular unfitness of a few miles, either unimproved or once improved and allowed to deteriorate. Bringing these roads into serviceable condition suggests itself as the first step.

Many roads are adequately surfaced, but bridges and culverts are weak or defective. The experience of the Goodyear Company of Akron, Ohio, in projecting their truck line from Akron to Boston illustrates this handicap. Because of weak bridges this company was unable to make use of the most desirable route—that through Cleveland, Buffalo ,and Albany—in spite of the fact that the distance is less, the grades easier, and the general character of the road surface superior. Consequently, they were forced to choose a road having twenty miles of unimproved clay and three mountain ranges to cross, through which an average speed of only six miles an hour has been possible. The construction of new bridges and culverts and strengthening those that are weak has been a frequent subject of discussion, but this is now a time for action rather than prolonged argument.

The great need for usable highways suggests an orderly progress from improvement in 1918, first, connecting the gaps in improved roads; second, proceeding to the improvement of main highways between important centres for commercial transportation; and, third, extending as rapidly as possible road improvements in farming country as an aid to the marketing of crops, and without which increased farm production is virtually prohibited.

Legislative Encouragement is Necessary

The substitution of legislative encouragement for restriction and the creation of endeavors to secure a wider use of highways are essential.

The experience of the Goodyear Tire and Rubber Company, previously cited, shows that the cost of motor truck hauling to them has been less than the cost of express shipping The saving in time over express and freight transportation has more than repaid the effort. The public generally will be in a position to take advantage of highway shipping once it appreciates the gravity of the situation which calls for relief, and the asset to be found in its highways.

The Shawinigan Water and Power Company have under consideration the extension of their carbide and electrode plants. Operations have been commenced on the large acetic acid works which the company are building at Shawinigan Falls for the United States Government, and part of the electrical equipment has been purchased.

Hog Raising on Garbage

Profitable Method of Disposal—Extracts from Pamphlet Issued by Commission of Conservation

THE feeding of garbage has met with varying degrees of success in a number of places in both Canada and the United States. In Canada the feeding of garbage to swine is conducted under license and inspection. It must be sterilized before being fed. The method of sterilization employed is to thoroughly boil the garbage before feeding.

The following is section 88¾ of the Animal Contagious Diseases Act:

> "The feeding of swine upon garbage or swill, either raw or cooked, obtained elsewhere than on the premises where fed, is prohibited, unless special permission is first obtained from the Veterinary Director-General."

Much of the most valuable garbage is already being used, as there are at present a number of licensed garbage feeders in the neighborhood of many of the cities in Canada, who contract with the hotels, restaurants, and larger boarding houses for their kitchen refuse.

Another point which must not be lost sight of is that the amount of garbage from cities and towns has recently been materially reduced by the practice of economy and the high cost of foodstuffs.

At Saskatoon, Sask., two men have built good piggeries and boiling rooms just outside the city limits. The city charges each man a $25 permit fee and inspects the feeding premises twice a month.

Writings to the Commission of Conservation regarding garbage feeding at Saskatoon, Arthur Wilson, medical health officer, and W. H. Orme, city veterinary inspector, state that:

> "There are from 500 to 800 hogs fed all the time, and during the past three months there were over 400 hogs fattened upon boiled garbage mixed with a small amount of grain and sold from both places. A conservative estimate would at least be 1,600 hogs fattened and marketed during the year. This is quite an addition to the bacon supply for the year from one small city, and all from garbage formerly removed to the nuisance ground at the city's expense.
>
> "In this city the feeding of boiled garbage to hogs according to our by-law has proven eminently successful, and if this method were to be put into effect in every town and city in Canada (which could very easily be done) the hog production could be very greatly increased this summer."

During the summer of 1917, Professor G. E. Day, of Guelph, visited Worcester, Mass., and Grand Rapids, Mich., for the purpose of studying the garbage feeding operations conducted there, and has kindly supplied the Commission of Conservation with the following notes regarding their methods of feeding, housing, breeding, etc.:

Feeding Garbage at Worcester, Mass.

The home farm, an institution for caring for the city's indigent poor, and containing about 600 acres, is the location used for feeding the garbage. The garbage is collected with teams and hauled to the farm. A falling off of about 40 per cent. has been noted last year as compared with the amount of garbage collected a few years ago. The farm feeds about 3,000 pigs and carries about 700 sows, which are bred twice a year, some farrowing in steam-heated pens during the winter months. The garbage is fed raw, which is claimed to be the best way of handling it. Cholera and kindred ailments are prevented by immunigation. The pigs are given a serum treatment at six weeks old and later, when they are about three months old or when they should weigh about 40 pounds, a serum and virus treatment.

It requires about ten men to take care of the pigs, three of whom are kept busy cleaning the pens and hauling away manure. The superintendent is very enthusiastic, and claims that at the present price of hogs, garbage is worth $10 per ton, and states that, under normal prices, if he could get garbage laid down at the feeding grounds for $1 per ton he could guarantee a 200 per cent. return on the capital investment. In 1914 the farm sold $38,000 worth of hogs and in 1917 over $50,000.

Garbage Contracts at Grand Rapids, Mich.

The city of Grand Rapids has made rules defining what is meant by garbage and the method which the householder is required to follow in his disposal of it. In substance these rules are:

Garbage is held to mean solids and liquids arising from the treatment of vegetable, fruit, fish, meats, or any waste materials that would attend the preparation, use, cooking or storing of household provisions. If any material should be put in the garbage cans other than as specified under the head of garbage, the collectors will refuse to take it, and the same must be disposed of by calling a special collector, for which a fee of 25 cents will be charged. Otherwise the garbage will be collected twice a week by the city free of charge. It may be added that the citizens are prohibited from disposing of garbage to any person or persons other than the city.

For transporting the garbage 50-ton steel railway cars are used. For emptying the collecting tanks into the cars a hoisting device with a track running over the cars makes it possible to perform this operation very quickly.

At present the stock on the farm comprises 300 cattle, 400 sheep, and 700 pigs, but there is not quite enough garbage to supply the requirements of all, and a certain amount of hay has been purchased for the cattle and sheep, though it is claimed that these latter prefer garbage to hay.

Purchased hogs do not thrive so well upon garbage as those bred from garbage-fed sows, and sows in pig freshly put on garbage diet are very apt to lose their litters. This necessitates the carrying of a large number of sows through from year to year and at least one mature boar for each fifty sows. According to estimates, one ton of garbage will feed 50 hogs of all ages one day, and one ton will feed 33 hogs one day during the finishing stage.

Quite a number of cities in the United States dispose of their garbage by a similar method to that described above. Arlington, Mass., Lowell, Mass., Providence, R.I., all dispose of their garbage to private companies, who feed it to live stock.

The Oliver Trading and Mining Company, of Mexico City, Mexico, sent a shipment of 200 tons of silver-gold ore, valued at $90,000, from Mexico to the Ladysmith smelter, Vancouver Island, only to find that plant closed down. The ore was brought to Vancouver and is being shipped back to California, and from there to a smelter at Douglas, Arizona, where it is hoped the plant will be able to take care of it.

Construction Features Maisonneuve Factory

Work on American Can Plant Finished to Schedule in Spite of Delays—Concrete Placed by Buggies—Interesting Specialties Used in Erection

ONE of the buildings erected in the Montreal district during the past season that is well worthy of mention, is the reinforced concrete factory building for the American Can Company in Maisonneuve, P.Q. The main building is 310 ft. x 90 ft., four storeys and basement high, of four-way mushroom type, flat slab construction. An adjoining building, the loading shed and garage, was also built in reinforced concrete.

The contract was let on May 28th, 1917, to the general contractors, the Norcross Brothers Company, Montreal, with a penalty and bonus clause in the contract for completion. In order to get a clear field on the site for the main building it was first necessary to erect the loading shed and garage. This loading shed and garage were erected substantially complete by July 10th, and it might be said the main building was commenced about July 15th, and was turned over to the owners on December 1st, a period of 4½ months.

In considering the erection program the contractors gave very careful thought to the question of spouting the concrete or distributing it by buggies, and partially because the engineer preferred placing by buggies they decided to adopt this method. Needless to say, it was very satisfactory, both as to time and cost.

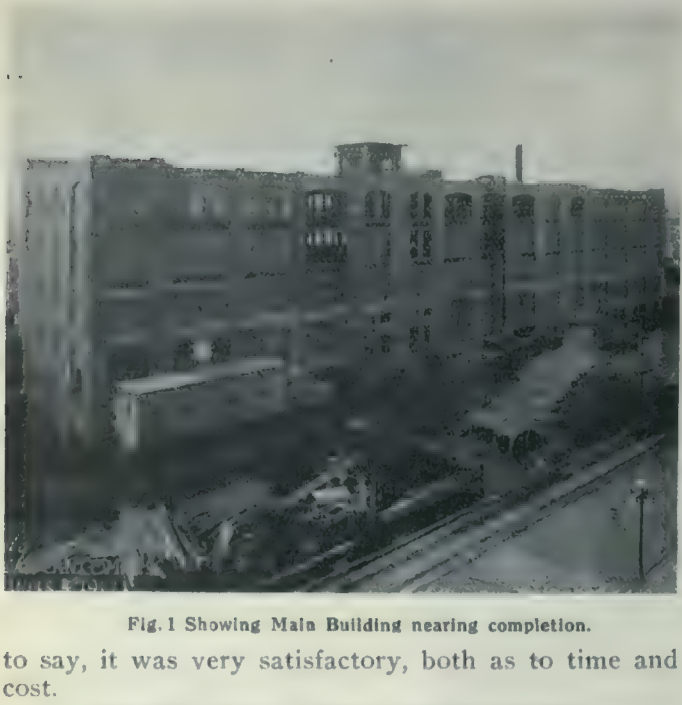

Fig. 1 Showing Main Building nearing completion.

Spacers Used in Placing Reinforcement

Reinforcement consisted of round munition steel, the longest lengths being 45 feet. There were several interesting specialties used in construction, among them being spacers made of strap iron, which correctly space and hold immovable the slab steel, also acting as a chair to locate the reinforcement properly in the slab. Slotted ceiling inserts were used in the ceilings, and in the columns ⅝-inch threaded inserts. All vertical column reinforcement was clamped, two clamps to each rod. Fig. 2 shows very clearly the design of the reinforcing.

With the exception of the top floor all the floors were impregnated with floor hardener, and these floors were installed by the "Monolithic" method, which consists of trowelling the slab and finishing the top surface within twenty-four hours after the slab has been poured, the floors then being protected with a 2-inch layer of wet sawdust. The top floor, which contains the lithographing department, was a composition floor, by the Special Service Flooring Corporation.

Windows and steel partitions are of Lupton design, steel partitions being used to enclose wash rooms, locker rooms, machine shop and various smaller enclosures, such as the main switch room, etc. The roofing consists of the Canadian H. W. Johns-Manville Company's 5-ply, with asbestile flashing.

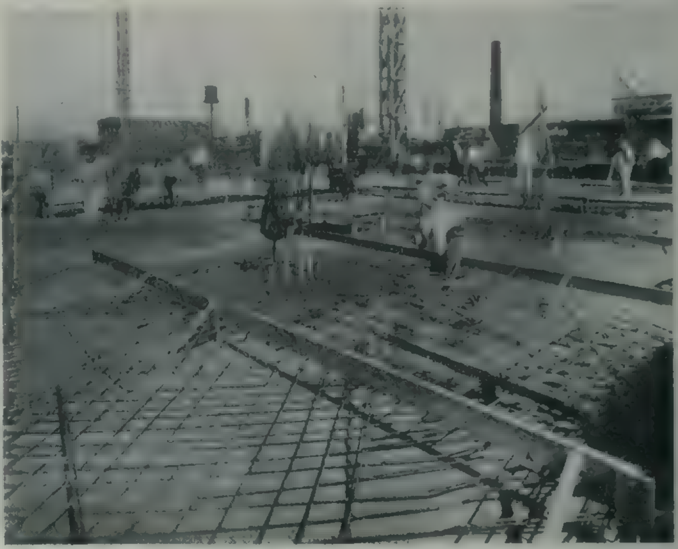

Fig. 2. Showing Method of Slab Reinforcement.

The coal bunkers are so designed as to minimize the handling of the coal. Two tracks are run over the top of the bunkers, with hatchways between the rails, so that the coal cars may be dumped directly into the bunkers. Fig. 3 shows the bunkers partly finished.

Mechanical Trades

The plumbing fixtures are of the very best type of vitreous enamelled ware, with the most modern fittings, valves, etc. In the heating arrangement boilers were put in large enough to supply heat for not only the new building, but the old as well. The heating consists entirely of wall radiation placed under the windows. The electric wiring is all of the exposed system, and can be easily rearranged to suit requirements for the disposition of machines.

For fire protection purposes sprinklers are provided on every floor, automatic fire doors at the stairs, and peele type elevator doors. As added protection in some cases, such as the bridge connecting the old with the new building, and in the garage, rolling steel doors were installed.

A building law made it necessary that the build-

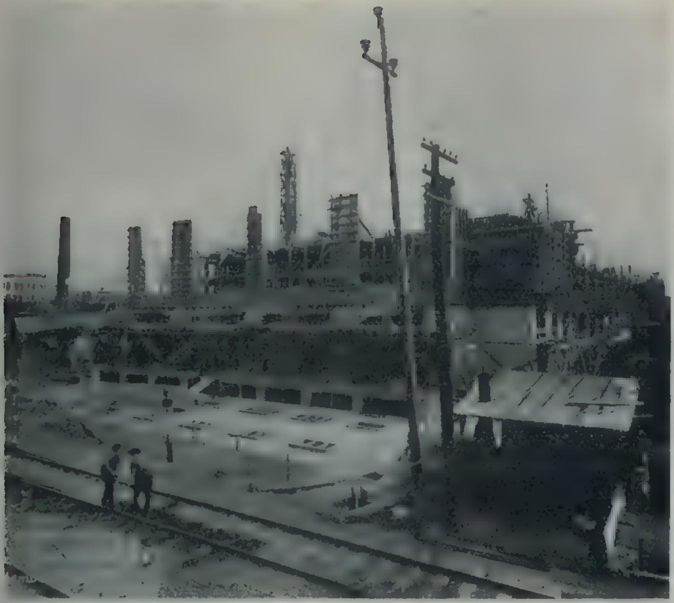

Fig. 3 Showing Coal Bunkers in the foreground.

ing be erected 14 feet back from the ordinary building line, which gave the engineer an opportunity to get excellent daylight into his basement. A wrought iron fence was erected on the street line, and from there the ground was sloped down, so that large windows could be installed in the basement, and the basement is nearly as well supplied with daylight as any of the other floors.

Sub-contractors

Cement floors were laid by the Builders Material Supply Company. Other sub-contractors were as follows:—Windows, steel partitions, elevator, fire and rolling steel doors, the A. B. Ormsby Co., Ltd.; roof, the Canadian H. W. Johns-Manville Co., Ltd.; plumbing and heating, W. G. Edge Limited; electric wiring, the Canadian Comstock Co.; sprinklers, the Canadian General Fire Extinguisher Co.

The contractors laid out a definite time schedule in detail for completion of the whole work, furnishing all sub-contractors with the same. Although a delay occurred of a little over a month in delivery of reinforcing steel; while a carpenters' strike caused a further delay of approximately ten days; and most unseasonable weather was experienced during construction, the contractors were able to deliver the building to the owners in the time agreed. This, of course, could not have been done without the active co-operation of the sub-contractors.

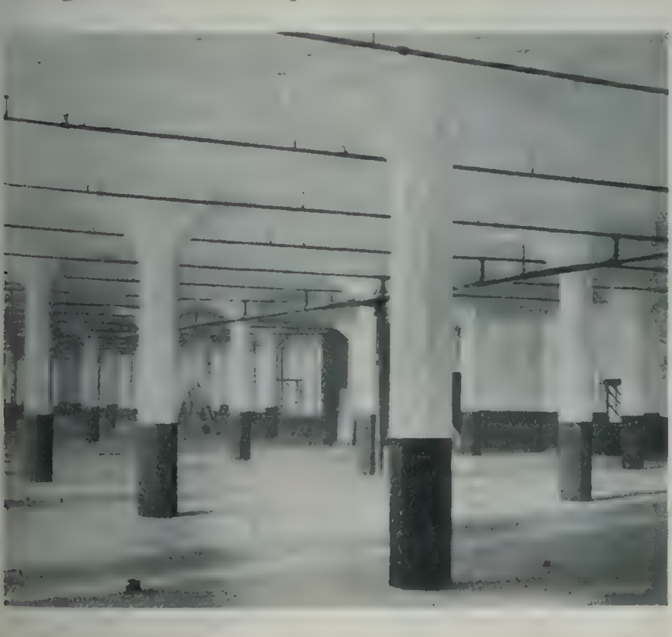

Fig. 4 Showing interior. Note flare of columns and drop of floor slab.

The Proposed Government Office Building At Ottawa

THE Department of Public Works have called for tenders for the erection of an office building at Ottawa on the corner of Queen and O'Con- for the Dominion Government to be erected nor Streets. The building will be 200 ft. x 100 ft., nine storeys and basement, and have about 700 rooms. It is estimated that the cost will be $1,500,000. The footings and basement walls will be of concrete thoroughly waterproofed. The skeleton will be of structural steel wrapped with wire mesh and encased in concrete. The external walls will be of terra cotta and the outside masonry will be grey granite, tooled six teeth to the inch, up to and including the plinth. The balance of the masonry will be of a grey or buff brick with a lime or sandstone trim selected by the architects.

The floor throughout will be of reinforced concrete 4½ inches thick—the section area of steel being .27 square inches per foot. The roof slab will be 4 inches thick and have a section area of .25 square inches. Where the concrete floors are left exposed they have a ½-inch finish of concrete treated with a waterproof hardener, expansion joints of felt and asphalt being provided every 10 feet.

The floors to the corridors and stair landings will be of 1¼ inch terrazzo. The offices will be covered with battleship linoleum cemented to the floor and nailed to bevel strips set in the floor at the openings. The main entrance floors will be treated with Canadian quarried marble and have a wainscotting and dado of the same material.

The roof will be of tarred felt and gravel, and the contractors undertake to keep it in repair for five years. Bronze thresholds, ornamental iron ballustrades with brass hand rails and ornamental iron grills to the windows are called for in the specifications. The base, picture mould, doors and architraves to the openings are to be Kalamein iron.

A vacuum cleaning outfit is to be provided. The heating is a two-pipe vacuum steam system, with two Plenum ventilating apparatus, and calls for five steam boilers, 66 inches in diameter and 16 feet long.

The electric wiring provides for the wiring and necessary fittings for electric lights, electric bells, telephones, fan motors, motor generators, storage batteries and fire alarms.

Purifying Water by Electrolysis

There has been recently placed on the market an appliance for sterilizing drinking water. It is also said to remove taste, odor, color, and hardness, and electrolysis is employed as the sterilizing agent. The appliance consists of a large glass jar, provided with a faucet and an electrode member. The latter consists of two plates, which are wired to the nearest source of lighting current. In operation the jar is filled with water and the current turned on. Depending on the amount of electrolyte salts in the water, a gallon of water can be purified in from ten to thirty minutes, and five gallons can be handled at one filling.

Three Rivers Steel Foundry

ONE of the first firms to establish a war industry in the city of Three Rivers, P.Q., was the Three River Steel Foundry Company, Ltd., who, having entered into a contract with the Imperial Munitions Board, erected a plant in that city and commenced their operations in August, 1917. The capital stock of the company was fixed at $100,000, and they spent $162,000 on the construction of their foundry, having been granted favors by the city.

The shop is 200 ft. x 90 ft. in plan, 50 ft. high, and is divided by a longitudinal row of interior columns into two sections—one 58 ft. wide and the other 32 ft. wide. The latter section contains the melting furnaces, the machine shop, and the power-house.

Oil-Burning Furnaces Used

The furnaces are heated by crude oil, and are built in cart crate and granboig bricks. They are four in number, each pair being used to heat one horizontal melting basin with a capacity of 25 tons. The pig iron is brought to the basins by means of small cars, which are hauled on a concrete side platform. The cars are operated by an electric motor, and the platform, in which rails are sunk, is reinforced with steel I-beams. At the back of the foundry there is another furnace, where the sand heads placed on the top of the moulds are fired to a temperature of 150 degrees.

The machine shop is equipped with two lathes and five cutting-off machines to give the wrought shell the specified dimensions. In a near future two other cutting-off machines for billet blanks will be added.

In the machine room are a 250 h.p. electric motor, operating an Ingersoll-Rand air compressor, 13¼ and 20¼ x 18, No. 19193, class BB2, and a 60 h.p. electric motor, used to operate the cutting-off machines. The electric motors were supplied by the Allis-Chalmers Bullock Company, Ltd., of Montreal. In the machine shop, beyond the lathes and cutting-off machines, there are also a boring machine and a planer. The company has provided for accident to the electric motor by installing a locomobile strong enough to operate the cutting-off machines. This engine was supplied by the Paquet Company, Quebec.

Exterior of Three Rivers Steel Foundry Co.'s plant.

The main bay is 58 ft. on the centres of columns, which support the plate girders. It has no second floor. A 35-ton horizontal travelling crane runs on full-length tracks, supported by the girders.

The columns in the centre row are proportioned for maximum dead load, besides a wind stress on the projected area of the building. Each column was erected in two sections, the upper one reaching from the running girder to the top of the roof. The lower one is really made with two separate columns, connected by solid bracing. The girder runs in the centre, and bears upon the two columns.

The roof truss is supported by the upper section of the columns, and the cantilever truss extends over the smaller section to the outside brick wall.

Interior of Three Rivers Steel Foundry

The walls on the east and north sides of the foundry are made of concrete blocks, which were furnished by Mr. Paul Dumoulin, Three Rivers. The west and south walls are of common red brick, which were furnished by the Citadel Brick Company, Quebec, at $11 per thousand. The window-sills are in reinforced concrete, with ½-in. reinforcement. This was decided upon on account of the vibration caused by the travelling crane. The roofing is hardwood, 2 in. x 3 in., covered with a special rubber paper. In the centre of the main bay there is a large concrete platform, 18 in. x 13 ft. x 135 ft., on which moulds are placed in three rows across the width. The melting steel is run into the moulds by means of a pot attached to the 30-ton travelling crane. The capacity of the pot is 25 tons. The crane is operated by two 15 horse-power electric motors.

Four crude oil tanks are situated on the western side of the foundry. Their collective capacity is 60,000 gallons. When one melting basin is used the company burns 18,000 gallons of oil per week; when the two are in operation, 30,000 gallons per week.

When in the moulds the shells are some 21 inches long, and their weight is 205 pounds. After cooling they are taken to the cutting-off machines, where they are cut to a length of 17 inches, reducing their weight to 162 pounds. Planers are also used to remove any deformation in the shell if necessary. The rejected shells are sent back to the melting basin.

The crane was furnished by the Lythe Engineering Company, Montreal, and the machines by the London Machine Tools Company, London, Ont. The steel for the erection of the plant was supplied by the Phoenix Bridge Company, Montreal, and amounts to 475,000 pounds. The total expenditure for the brick was $25,964.17, and the machinery cost $50,000. The general contractors were Messrs. Gagnon & Massicotte, Three Rivers, Que.

Bridge Linking Winnipeg and St. Boniface

The new Provencher Avenue bridge, spanning the Red River and linking up Winnipeg and St. Boniface, will probably be completed in July. The bridge is of steel, about 900 ft. long and 68 ft. wide, and spans the Red River from Provencher Avenue, St. Boniface, diagonally to the north end of Christie Street, Winnipeg. From Provencher Avenue to the beginning of the Winnipeg approach it runs in a straight line and then curves slightly in a northerly direction to the point where Christie and Water Streets meet. It rests on eight piers, six of which are built in the river-bed, grounded in the underlying limestone formation, at a depth of between 40 and 60 ft. from the average low-water mark level. Some of the steel girders in the superstructure measure 105 ft. in length, 10 ft. high, and weigh between 64 and 75 tons. The clear width of roadway is 46 ft. between the girders, which will project some four feet above the bridge floor, and 10-foot sidewalks extend on either side, closed in by ornamental steel balustrades. The two central piers have about three times the bulk of the other piers, as they shelter the machinery that will operate the two movable spans. It will take 20 seconds to raise these spans and two minutes to let them down. The cost of the substructure, for which McDonald & McGoogan Company were awarded the contract, was $285,000, and the Dominion Bridge Companv have the superstructure contract at $306,507. Carter-Halls-Aldinger Company are subcontractors to the latter firm for the paving work. When completed it is probable the total cost of the structure will be between $625,000 and $650,000. Chief Bridge Engineer J. G. Legrand, of the Grand Trunk Railway, and Engineer H. N. Ruttan, of the city of Winnipeg, are chiefly responsible for the design of the bridge. Engineers Ruttan and Sedjack are superintending the construction.

A bill is before the State Legislature of New York to protect from financial loss those who entered into contracts for public improvements before the declaration of war with Germany. The bill, among other things, permits the completion of contracted work at actual cost without profit to the contractor and indefinite suspension or re-letting of the work.

A large number of tenders have been sent in for the proposed Government office building, Ottawa. It is understood, however, that the estimates are all higher than the money appropriated, and that the plans will be revised and new bids asked for.

Acetylene ash, the residue of the decomposed carbide, is said to have been successfully used for making plaster and whitewash and as a substitute for marble dust for surfacing asphalt highways.

Engineer Alleges Aldermanic Interference

Mr. A. S. Clarson, city engineer of Verdun, P.Q., has resented what he declares to be constant unwarrantable interference with his work by two aldermen, and gratuitous insults, both in public and private, by one or two aldermen; and he also complained of an inadequate staff. Under such circumstances he tendered his resignation. Mr. Clarson stated that, in view of the conditions, "I cannot retain my position as city engineer and at the same time retain my self-respect, and naturally I prefer the latter." He named two aldermen who, he said, had interfered with the city engineer's work, but denials were given by these representatives to the statements of Mr. Clarson. By a vote of 4 to 2 the Council asked Mr. Clarson to reconsider his resignation.

In a despatch from Prince Rupert, dated March 14. it is reported that all work at the big drydock at that point has been shut down. Although no official announcement has been made, it is stated that the move foreshadows the lease the plant to American interests.

The contract for the dam and concrete power-house of the new development of the Southern Canada Power Company, on the St. Francis River, at Drummondville, P.Q., has been let to Morrow & Beatty, Ltd., Peterborough. It is proposed to develop 10,000 h.p., but provision is being made in the power-house for ultimate development of 18,000 h.p. The work will include about 80 miles of new transmission lines for linking up parts of the system.

Mr. W. G. Yorston, M.C.S.C.E., Hailfax, has been appointed chief engineer of the Nova Scotia Highways Commission by the provincial government. Under the new law statute labor is abolished.

Mainly Constructional

East and West—From Coast to Coast

The secretary of the Montreal Builders' Exchange has, on instructions by the board of directors, written to the Hon. Mr. Carvell, Federal Minister of Public Works, asking that all tenders for public works undertaken by his department be opened in the presence of the various competing contractorrs.

Building permits issued in Montreal in the month of March number 90, and are valued at $241,660, as compared with 105 permits, value $343,460, in March, 1917. From January 1 to March 31 the total is 174, value $434,815, as against 193 at a value of $995,920, in the corresponding period in 1917.

Delegates from Port Colborne, Ont., recently addressed the Welland County Council asking that the high road between Port Colborne and Welland should be completed right to Welland. The council, however, decided that the county outfit should first be used on the repairing of roads now needing attention. When the repairs are completed the construction of the road between Niddle's Crossing and Garrison Road, commenced in 1917, would be continued to completion, if possible.

The Council of Weston, Ont., has decided to purchase three filters from the city of Stratford, at a cost of $7,800 f.o.b. The total cost of the equipment installed complete will be between $18,000 and $20,000. The filtering capacity will thus be raised to about 1,100 gallons per minute. At present a 150-gallon-per-minute installation is being forced to handle a 400-gallon supply.

The construction of the new Saskatchewan Co-operative elevator in Port Arthur, Ont., will commence on May 1. Plans and specifications have been prepared by Mr. C. D. Howe, consulting engineer, and tenders called. The pile foundations have been completed and are ready for the superstructure. Construction work is to be rushed with all possible speed.

Building work in Vancouver, B.C., shows signs of picking up. Building Inspector McKenzie reports the issuing of 64 permits, valued at $79,170, during the month of March, as compared with 46, valued at $33,715, in the same month last year. For the first three months of the year the total is 153 permits, at a value of $181,480, while during the corresponding period in 1917 there were 119 permits issued, valued at $159,540.

At a recent meeting of the Toronto Board of Control it was decided to call a conference of the railway officials, harbor commissioners, and Board of Trade to come to some agreement regarding the use of the new Union Station, which will be ready for occupation this year, whereas the viaduct cannot be completed for ten years. The Board of Control wish to make arrangements for the interim use of the new building, pending the construction of the viaduct.

The rural municipality of Sherwood, Sask., will co-operate with the provincial department of highways in its scheme to link up the roads in the various municipalities throughout the province for the purpose of creating a system of main highways and main crossroads in Saskatchewan. The municipal council decided that Mr. J. A. McDonald, its newly-appointed road commissioner, during the course of this year, should make a complete survey of the roads throughout the municipality, and that maps would be prepared in conformity with the plans laid down by the department of highways.

The matter of the bridge over Mimico Creek, on the Toronto-Hamilton Highway, has again been brought before the Ontario Railway Board. On the previous occasion it was determined that a steel bridge should be placed on the highway, instead of a concrete bridge, and the cost was to be about $25,000. Investigation, however, proved that the steel bridge would cost more than this amount, and it was claimed that a different design of concrete bridge would be less expensive. It was finally decided that the engineer of the highway commission and the engineers of the county and municipalities concerned should get together and report on April 18.

The Good Roads Committee of Welland County recently submitted a report to the council regarding the condition of the county roads. Amongst other recommendations they advised that more oil be purchased this year, to be applied on roads that are in good condition; and also that a sprayer tank and sweeper be purchased with which to make the application. They also believed it imperative that more attention be directed to the cleaning of the ditches and culverts in the fall, in order that the water would have free course and not remain along the sides of the roads. It was also recommended that three or four cars of small stone be purchased, to place on the roads at once before the dry season comes on.

Mr. John Laxton, Sr., of the Toronto Harbor Commission, recently returned to the city after an extended tour of the Western States. Mr. Laxton, whose interest has been centered in the progress of public works in the United States along similar lines to that of the Toronto Harbor Commission, since the entry of the United States into the war, said the principle of "carrying on" was being observed in many of the cities on the other side of the line, where water-front improvements are being promoted on an extensive scale. Referring to the local harbor development work, he said he hoped there would not be a complete cessation of the work till after the war. He believed there was some work that could be carried on to good advantage.

Hon. Frank B. Carvell, Minister of Public Works, recently received a large deputation from the Counties of Norfolk, Brant, Waterloo, and Oxford, requesting that the harbor at Port Dover, Ont., be taken over and improved by the government. In the course of his reply the Minister said: "I am pretty sure that an order-in-council has been passed by the government practically retaking charge of the harbor of Port Dover, and, if it is has not yet been passed, I am pretty sure it will be, and that everything that is necessary will be done for the adequate development of the harbor, under the auspices of the Public Works Department." Hon. William Charlton, one of the spokesmen for the deputation, pointed out that, according to government engineers who recently completed an investigation and report, Port Dover harbor could be improved by one scheme, at a cost of $234,000, and by an alternative scheme, at $576,000. He believed temporary repairs, which would suffice till after the war, would cost $60,000 to $75,000. He said that the Grand Trunk, who now control the harbor, had hindered progress in that part of Ontario.

A new industry for the manufacture of ferro-silicon is soon to be established at Beaupre, P.Q. The plant, which is already under way, will be of brick and steel construction, and will have three furnace rooms, each 15 ft. x 50 ft. The electric station for supplying the furnaces with power will be 160 ft. x 20 ft. Mr. E. A. Wallberg, of Montreal, who is largely interested in the Laurentian Power Company, of Seven Falls, several miles below Beaupre, is at the head of the project, and Mr. James Ruddick, also of Montreal, who is manager and engineer of the Laurentian Power Company, is the manager of the new concern. The company has a large contract with the Imperial Munitions Board for the manufacture of ferro-silicon, and it is expected that the plant will be in operation within three months' time, with a daily output of 12 to 15 tons, and employing a staff of one hundred or more. The contract for the steel to be used in the building has been awarded to the Eastern Canada Steel Company, and Mr. Walter Sharpe is the general contractor. The electric power will be supplied by the Laurentian Company. Beaupre, the site of the plant, is a short distance below Quebec City, on the line of the Quebec Railway, Light, Heat and Power Company.

Personals

Mr. Oscar Morin, one of the legal advisors of the city of Quebec, has been appointed deputy minister of the newly-created department of municipal affairs.

Mr. Bruce R. Erb, advertising manager, T. McAvity & Sons, Ltd., St. John, N.B., has enlisted in the Royal Canadian Engineers, and goes into training on April 15, in St. John's, Que.

Mr. J. W. Adams, city engineer of Chatham, Ont., has tendered his resignation to the City Council. Mr. Adams succeeded his brother, Major F. P. Adams, following the departure of the latter overseas with the 186th Battalion.

Lieut. Alexander Ross Robertson, a 1908 graduate of the Faculty of Applied Science and Engineering, of Toronto University, is reported wounded. Lieut. Robertson went overseas with the 169th Battalion and while in England was made Captain-Adjutant to Col. Chisholm. In order to get to France he reverted his rank and went to the front with the 20th Battalion. Previous to his enlistment he had been with McGregor & McIntyre, structural steel works, Toronto. He was wounded in the right arm.

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The Persistent Practice of Employing Aliens

SEVERAL months ago, following the letting of certain Canadian contracts to alien firms, there was a meeting of the interested trades and professions to protest against the "persistent and growing practice of employing alien architects, engineers, and contractors on large public works in Canada." A memorial was drawn up for presentation to the federal government, but, owing to the absence of Sir Robert Borden in Europe, it was considered inopportune to press the matter at that time. The attitude of the meeting, however, was definite and unanimous that Canadians were being unfairly and unnecessarily discriminated against.

The agitation has now again assumed proportions, however, the arguments previously advanced being further strengthened by the present alarming condition of trade balance between Canada and the United States. To remedy this condition the Dominion Government is asking power to take drastic measures in the way of prohibiting imports, which threatens to inconvenience at best, and in certain cases, perhaps, cripple, Canadian industries and other activities. In this connection it is pointed out—and with justice, we believe—that much of the present predicament would have been avoided if the "persistent practices" spoken of above had been discouraged long ago. It is argued, for example, that the employment of a United States architect or engineer is generally followed by the letting of the contract to a United States contractor, who, in turn, employs a United States staff and purchases, in large measure, United States materials. Of course, much of the money given in payment for this service and goods goes out of the country.

In time of war one always hesitates to criticize one's governing bodies, who, of necessity, see such matters from more angles than anyone outside the inner circle can possibly do. For this reason a number of contracts awarded in recent months to aliens have been passed over in silent disapproval. This silence must not be misinterpreted, however. It is not in any sense an acknowledgement of the superiority of aliens; it is not a sign of resignation to established conditions; it is merely an attitude of mind which says: "We will do nothing at the moment to embarrass or hamper or add to the worries of our governments"—an attitude which, it is hoped, those governments will appreciate.

At the moment there seems to be little that can be done beyond educating the general public that there are as efficient architects, contractors and engineers right among us as may be found by going farther afield. A man's accomplishments travel farther and live longer, in general, than his mistakes, especially if he is a personal advertiser, and, in a word, perhaps this is the secret of the whole matter. Canadians are not as good or as persistent advertisers as they might be, or as many of their alien competitors are, and so are not known even locally as well as many aliens who announce their accomplishments from the house-tops. These are times when people **expect** all wares to be advertised—an absence of publicity is thus an acknowledgement of inferiority.

Fast Drivers Have Nothing To Do When They Get There

"THE majority of fast drivers have nothing to do when they get there," a trite expression of Mr. W. A. McLean, in a little pamphlet he has just written for the Ontario Safety League, could well be made the text of a sermon not only on the "danger" feature of reckless driving, but also on the "expense" feature, to say nothing of the annoyance and inconvenience this disregard for the rights of others entails. By "expense" is meant expense of building the roads and expense of maintaining—chiefly the latter, which is greatly increased by unnecessarily fast driving.

There is not nearly so great a demand by motorists for uncontrolled license in the way of speeding as was formerly the case. Perhaps the craze for scorching has expended itself. Perhaps—and let us be generous enough to believe it—the average motorist has re-remembered what he forgot in the first ecstacy of his new motor—that there are still pedestrians who thrive as little as ever on a dust diet. Perhaps it is out of consideration for the ratepayers who maintain the roads. Perhaps he has sat down and communed with himself along the line Mr. McLean suggests and has realized that there is really no such urgent need that he should reach his destination.

This being the case, the law is now made, as laws should always be, for the irresponsible, the individual pre-eminently, with no objective in place or time or work. Such people are a menace and a nuisance. The preservation of our roads and the safety of the travelling public is of much more importance than the pleasure of this minority class.

The Manufacture of Ordnance

LIEUT. Edgar A. Jamieson, inspector of guns and steel, brought out many interesting points in gun manufacture in a paper read before a recent meeting of the Ottawa branch of the Canadian Society of Civil Engineers.

"A gun," said the speaker, "may be considered as a strongly constructed tube intended to stand a given internal pressure, and throwing a projectile which shall produce certain effects at given distances.

"In constructing such a bore, we have first to consider what will be the pressure it will be called upon to stand at the various sections along its length and so arrange the material that there is everywhere an ample margin of strength. The bore should also be of such material as to stand the wear and tear of firing a large number of rounds without becoming so worn or eroded as to interfere with accurate shooting.

No Waste of Strength

"While arranging the material so as to obtain the necessary surplus of strength over estimated pressure, it must also be borne in mind that in order to prevent the gun becoming too heavy, the material must be so placed that there is no waste of strength, i.e., each part must be so constructed that it performs its own share in resisting the pressures set up.

"The least complicated method of manufacturing a gun would appear to be that of casting a homogeneous hollow cylinder; but if we take such a tube we find its tangential strength to resist an internal pressure does not increase uniformly with its thickness; also, it is known that no single (or homogeneous) cylinder, however thick, can stand a pressure greater than the elastic limit of its material.

Built Up Systems

"In order then to obtain a gun in which we can use the high service chamber pressures (up to 20 tons per square inch) now obtainable, it is necessary to resort to the "built up" system; i.e., the gun instead of consisting of a single cylinder is made up of various layers of steel, or steel and wire, the necessary increase of radial strength being obtained by submitting the inner layers to initial compression by means of wire-winding, shrinkage, or 'tupping.'

"By these methods of construction each layer of material is made to take its share of the stress induced when the gun is fired.

"In order that the gun may be built with the required shrinkage, the surfaces of the various cylinders must be strictly in accordance with the figures given on the drawings. The allowed variations from dimensions are kept to the lowest possible limits and accurate measurements and careful examinations of the various parts are made from time to time at the different stages of manufacture, and also after proof firing.

Two General Systems

"Guns are built on two general systems, one in which the gun is entirely of steel and the other where steel and wire winding are combined, the latter giving greater radial strength for the same weight.

"The most ordinary principles of construction are embodied in the 6-in. 26-cwt. howitzer, which is a good medium type of gun. This howitzer is of steel and wire construction and consists of an inner barrel called the "A" tube, over the front end of which a muzzle wire stop ring is shrunk. Wire is then wound over the exterior of the "A" tube from the breech and to the stop ring. Over the "A" tube, wire, and stop ring is shrunk the jacket secured longitudinally by the breech bush which is screwed into the rear end of this jacket; the bush is also screwed internally to take the breech screw. At the rear of the jacket is screwed and shrunk the breech ring which is provided with lugs to take the breech mechanism and to attach the howitzer to its carriage. The exterior of the jacket is furnished with two feet or rests to form guides and engage in cradle of mounting and similar projections are formed on the front guide ring which is screwed and shrunk on to the forward portion of the jacket.

"The chamber is cylindrical, coned at the front end. The weight of the finished howitzer with mechanism is 26 hundredweight and without mechanism and fittings the weight is 23½ hundredweight. The projectile from this howitzer weighs 100 pounds and can be thrown a distance that is probably best left unmentioned.

"A rough and ready method of estimating the time required to complete the manufacture of any type of gun is to allow one month for every inch of calibre."

Modern Varnish Making

Mr. Norman Holland, president of the Holland Varnish Company, Limited, read a paper before the Canadian Society of Civil Engineers, Montreal, on April 11th, on "Modern Varnish Making." He described the process of manufacture and enumerated the various oils and gums which enter into the making of varnish. Mr. Holland also spoke of the methods by which the nuts, oils and gums are gathered and prepared in many countries, and told of the means of transportation from the interiors to the coast. The qualities and uses of these ingredients were described, comment also being made on the phenomenal advance in prices due to the war. Mr. Holland added that there was no such thing on the market as pure raw linseed oil, and it was a mistake to suppose that pure linseed oil was used in making paints; other oils were added. The price of pure raw linseed oil prohibited its use in the making of paint. The address was illustrated by a number of slides, showing views in many countries, and also tracing the various stages of manufacture, from the collection and crude preparation of nuts, oils and gums to the finished product.

Conserving Nova Scotia Water Powers

Following recent conferences between Mr. J. B. Challies, superintendent of the Dominion Water Power Branch and the Nova Scotia Water Power Commission, there was introduced in the Legislature of Nova Scotia last week a comprehensive water power bill declaring the ownership of the crown in the right of the province of all water and water-power in Nova Scotia, and providing for administrative regulations to be approved by the governor-in-council. The legislation as introduced is considered to be comprehensive and timely, and should greatly assist in the conservation and use of the many favorably located undeveloped water-powers in Nova Scotia.

Extension to C.P.R. Pier "D", Vancouver

Now One of the Largest Structures on the Coast—Piles up to 125 ft. Long Required for Substructure — Heavy Fill Displaces Soft Harbor Bottom

THE Canadian Pacific Railway have recently completed an extension to one of their piers at Vancouver, B.C., which makes the new pier one of the largest structures of the kind on the Pacific Coast. The extension was made necessary by the steady growth of coastwise and trans-Pacific traffic. The pier is a creosoted pile structure, and on account of the depths of water and mud encountered, is of considerable interest from an engineering standpoint.

The pier is known as Pier "D," and is located on Burrard Inlet, at the foot of Granville Street. The older portion of the pier was built in 1913, and measured approximately 376 feet by 150 feet. It carried a two-storey structure, the lower deck being devoted to freight, the upper to passenger traffic and various offices for operating; also customs and immigration officials. The primary use of the old pier was for coastwise traffic.

Accommodates Coastwise and Trans-Pacific Traffic

The extension measures approximately 537 feet by 160 feet, and runs to the harbor line, making the entire pier about 914 feet long on its centre line. As the pier has two distinct uses, namely, for coastwise and trans-Pacific traffic, it is so designed, the west and north sides being primarily intended for the coast boats and the east side for trans-Pacific and miscellaneous freight traffic. The west and north sides have complete arrangements for berthing four coast boats at one time. These arrangements comprise, in general, separate passenger ramps or stairways, each taking the passengers direct from the boat to the upper floor level without interference with the freight traffic. The east side is designed with continuous sliding doors, giving openings as desired at any point along practically the entire length of the pier. Two heavy adjustable freight slips are also installed, together with a standard-gauge railroad track, which runs the entire length of the east side and makes it possible to deliver open-car freight directly under the ship's slings. The east and west sides of the pier are divided by a depressed standard-gauge track running down the centre of the pier and serving both sides. A one-storey shed of heavy mill type construction is built over the new pier, on top of which is a promenade connected with the lower deck by stairways on the west and north sides. This promenade is designed for passenger traffic, but also serves for sightseeing purposes, as it affords a good view of Vancouver harbor.

The old pier was a creosoted pile structure, and a study established the desirability of making the new structure of the same general type. Test holes in or near the area of the extension showed depths of water of from 40 to 70 feet at mean low tide. The tide range is approximately 16 feet. The harbor bottom itself was a mixture of mud, silt, sand, and shell, ranging from 10 to 30 feet in depth, and, below this, strata of clay and gravel. Hardpan lay variously at from 70 to 140 feet below low tide. It was apparent that a fill would have to be made, and the material for it was readily obtained from a dredging contractor who was making channel improvements at the First Narrows, about two miles from the pier site. About 250,000 cubic yards of material were used.

Fill Used to Solidify Foundation

The fill had a dual purpose—first, to displace the soft harbor bottom; and, second, to provide end and lateral support to the piles to be driven into it. The theory was that the fill would gradually both displace and compress the lighter and softer material beneath until a point of equilibrium was reached and no further settlement of the fill occurred. If at that time an amount was dredged off the fill roughly approximating the weight of the structure later to be placed upon it, the ability of the underlying material to stand the load could be reasonably relied upon.

Careful weekly soundings were kept over the entire area covered by the fill, as also along lines parallel to and outside of it. These soundings showed a slow but fairly continuous settlement on the part of the fill and a slow corresponding rise at the bottom outside of it, until after a considerable period no further settlement could be observed. As was expected, that part of the

C.P.R. Pier "D", Vancouver, recently extended to handle trans-Pacific traffic.

fill next to the old pier came to rest first, and permitted pile driving to be begun at a time when the outer portion of the fill was still in movement.

The type of substructure for the pier was fully considered, and it was evident that creosoted wooden piling would be the cheap and logical solution of the problem. It was desired, so far as possible, to have the piling penetrate the fill and rest on the harbor bottom beneath, thereby increasing the area of surfact contact, as well as assuring full bearing power, and therefore safety, in case of any future movement on the part of the fill itself. To do this piling lengths considerably over any known lengths for concrete piles were required. As the teredo is active in these waters, a treated pile was necessary. Creosoted Douglas fir piles with full 15-pound treatment under the boiling process were, therefore, determined upon. All other established methods for pile preservation were, however, considered before final decision was made. The contract called for approximately 2,550 piles from 85 to 125 feet long. It was also decided that all deck timber which was either in contact with the water or near enough to it to be continually damp should be treated. Bracing, caps, stringers, and laminated deck timber were, therefore, specified for 12-pound treatment under the boiling process. All timber was to be of Douglas fir and of standard specifications.

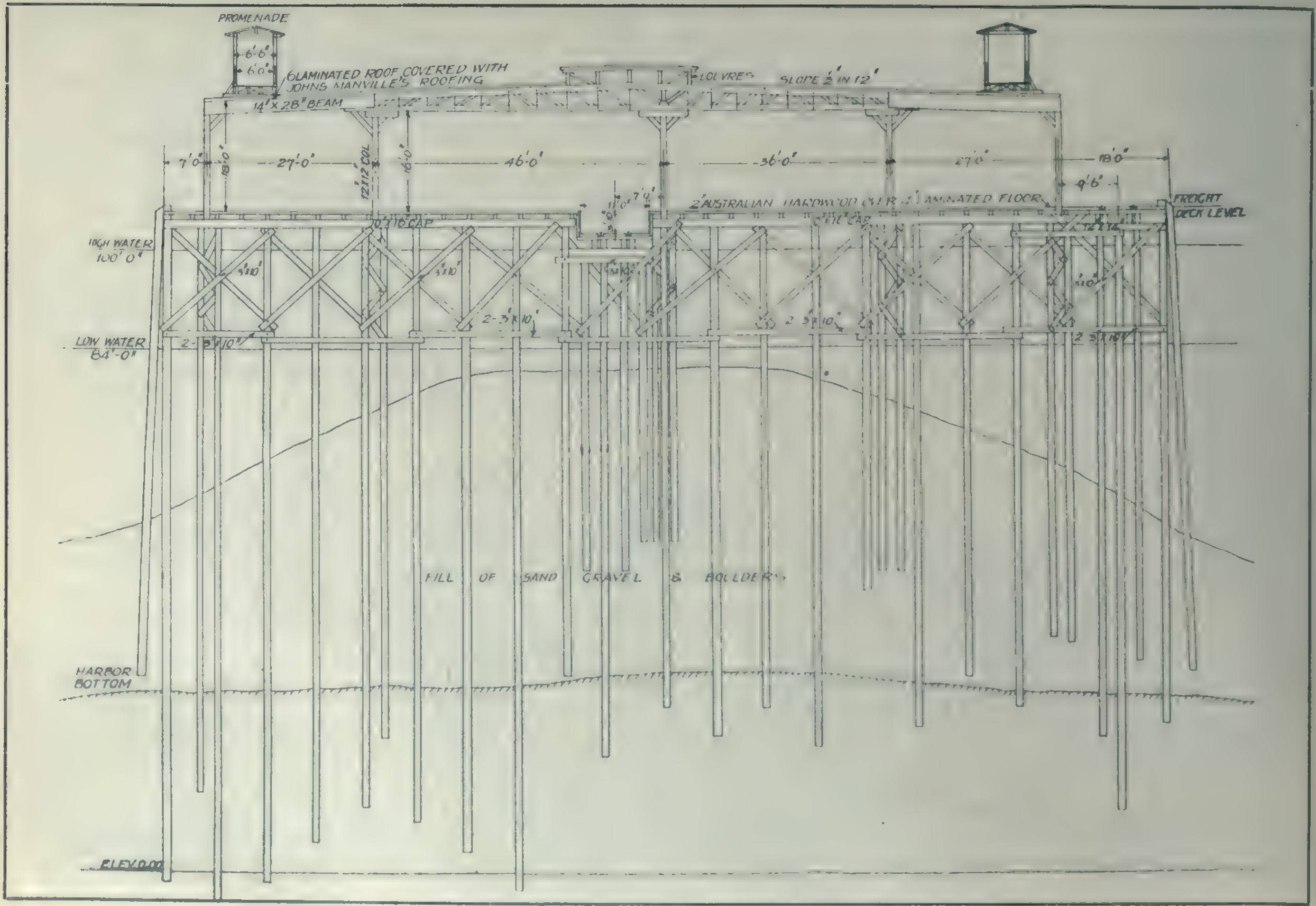
Scow-Driver With Leads 130 ft. High

The pile-driving work was given to Mr. S. Doe, of Victoria. As there was no rig available for handling piles of the weight and lengths of those to be used, Mr. Doe built a special scow-driver, with leads measuring 130 feet in height. So far as is known, this is one of the largest, if not the largest, scow driver ever built.

As there was a large amount of boring and drift bolting to be done, a motor-driven air compressor was installed, pipe lines extended from it, and connections tapped in at intervals with hose to the various air tools. These comprised air riveters with special sets for drift bolt driving, and boring machines of various sizes. The borers were especially useful in laying the 2 in. x 4 in. Australian hardwood which served as flooring, and which had to be bored for nailing. This boring alone required approximately 70,000 holes.

Another useful machine was a small travelling derrick running on a track laid across the pier, and so arranged that it could be jacked up on rollers and moved forward under its own power. This moving operation took about two hours. About 40 lineal feet of pier could be handled from each position of the track. The derrick was used for handling all creosoted timber (which was delivered on scows alongside as required), picking up, moving across the dock, and depositing in place. The average time for handling the 7 in. x 12 in. x 40 ft. stringers from the scow to the far side of the dock and back again for another load was approximately two minutes.

A skid driver was used to drive the track extension along the old pier and a few column piles under the old deck, which had been omitted in building the original pier. When its pile-driving work was finished it was turned into a skid derrick, with an 80 ft. boom, and used to erect the roof trusses, which were framed and assembled on the deck and lifted complete onto the columns in one operation. This derrick was used to raise the 2 in. x 6 in. laminated roofing, a team load at a time. It also performed a variety of miscellaneous



Transverse section through one-storey shed—Piles spaced 6' 8" centres longitudinally.

work, as its long boom and skids made it a very handy rig.

A fully equipped blacksmith shop was built on a small scow, to avoid fire risk, and moored alongside of or near the dock, while field office, storehouse, and compressor house were located at the extreme end of the old pier, outside of the shed, where they would not interfere with the operation of the pier and yet be easily accessible.

Record Kept of Each Pile

While piles were being treated, inspectors were kept at each plant, and the quantity and quality of creosote used, temperatures, pressures, and time of treatment were carefully watched and recorded. Each pile was numbered and stamped after being passed and full data on its treatment recorded. When driving, a report was also made by an inspector on each driver as to the pile number, location, penetration, and length of cut-off. It was thus possible to readily trace the history of any pile from its time of treatment until driven. All piles were spotted by transit and stayed soon after driving. The driving at all times was extremely hard. Piles were driven on 6 ft. 8 in. x 8 ft. centres.

Piles were capped by 10 in. x 16 in. and 12 in. x 14 in. creosoted timbers, drift-bolted into place. Capping was kept several bents behind the pile-driving, so that the jar from the driving would not change the elevation of the piles after being cut off. Creosoted stringers were laid across the caps and drift-bolted to them. A laminated creosoted 2 in. x 4 in. decking was laid diagonally on the stringers, the idea being to give additional rigidity by tying several parallel pile bents together in this way. Piles were also braced diagonally and additional longitudinal bracing was run down each side of the depressed track. The outside railroad track had its own special bracing. Walïng was also installed at periods of maximum low water. On the laminated deck there was laid a flooring of 2 in. x 4 in. Australian hardwood running parallel to the pile bents. This flooring was air-bored and spiked with great care to get a tight joint.

Features of Shed Construction

The shed area was divided down the middle by a depressed standard-gauge track which brought the car doors at the deck level. The area on each side of the track was divided into bays 36 ft. and 46 ft. wide respectively, with outside bays of 27 ft. each, with roof columns 20 ft. centres longitudinally These columns were posts carried on special piles, independent of the rest of the substructure. The roof was required to bear not only its own weight, plus snow and wind load, but also a promenade with a live load, the total load under the promenade section being about 150 pounds per square foot. It was also desired to have the roof line match that of the old pier, and at the same time keep a minimum clearance of 16 feet under the trusses in the shed. The wooden trusses over the centre bays were 82 feet long, and designed with separate members of 14 in. x 28 in. x 28 ft. over the outside bays. The roof itself was made up of 2 in. x 6 in. x 30 ft. lamination, covered by a three-ply asbestos roofing, mopped on. A low monitor ventilated by fixed louvres was run down the centre of the roof and also extended over the old portion of the shed. Running around the outer edge of the roof is a covered promenade 6 ft. wide. Two stairways lead from it to the lower outside deck. On the east side the promenade railing is in removable sections, as it is planned to land trans-Pacific passenger traffic to this promenade, and so avoid passenger movement on the lower freight level. A heavy removable passenger gangway runs on the east side railroad track, and is provided with adjustable landing gangways on each side between itself, the ship, and the promenade. The passenger bridge was originally on the east side of the pier and was moved to the west side. The space formerly occupied by it was closed up and turned into offices.

The entire east side of the pier is made up of continuous sliding doors. There are 95 of these, running on two parallel tracks and overlapping. The doors are hung on adjustable rollers, which will take up settlement. The bottom track is made up of "T" and angle irons, left open through the deck so that nothing can collect to interfere with the working of the doors. The doors are glazed in the upper half and screened, with a 3 ft. section of window above them to provide additional light. The west side walls are made up of short sections of continuous doors, a few sliding doors, and solid wall. The wall is made up of shiplap, covered with corrugated iron. The north wall is provided with two doors.

Freight Handling Equipment

Three freight elevators of the Barlow type were installed, one being a new machine and the other two being transferred from former locations on or near Pier "D." Two adjustable freight slips were also installed. As the east side track crosses these slips a device was worked out so that this section of track operates with a turntable. When the slip is up the track is locked in place and supported rigidly on the pile bents. When the slip is down the track is given a quarter turn, so that the rails lie parallel to the slip axis, and can be readily trucked over. Each slip is operated by two worms and gears on a common shaft with endless hand-chain attachments. The slips are supported by steel hooks, which drop back when the slip is to be lowered, by means of a lever pulled from the deck level.

The centre depressed track is fitted with an electrically driven car-haul, with a capacity of 10 loaded cars. Its use will avoid the presence of any steam locomotives inside the pier, with their attendant fire risk and smoke.

Motors with a total capacity of about 200 h.p. are installed on the pier. The current is brought to a concrete transformer station at the south ends of the pier and distributed in ducts. No transformers are allowed on the pier on account of fire hazard. Lighting current is also transformed off the pier and distributed by conduit, the circuits being arranged so that practically any combination of lights can be obtained. Lighting plugs are installed along the side of the depressed track, to provide for portable lights for loading and unloading freight cars. Screened bracket lights are placed at 40 ft. intervals around the outside of the shed and red and green beacon lights at the outer end. An electric fog bell is also installed.

Fuel oil lines are carried down each side of the pier, with valves at the various boat landings. A covered water line is laid along the bottom of the roof trusses, and branch lines are taken off at intervals for supplying the boats and for fire protection. Hose valves and lines of hose laid on tilting hose racks are also supplied, and so arranged as to cover the entire pier area. Five bubbler type drinking fountains are installed and two toilets.

Alterations to Old Pier

A considerable amount of miscellaneous work was necessary to adapt the old pier to the increased traffic.

The upstairs offices had to be considerably enlarged and revised and facilities formerly in the office space moved to new locations. Small enclosures also had to be built for customs, baggage, express, and similar purposes. At the south end of the pier one of the steel columns supporting a part of the Granville Street ramp and the southeast corner of the pier structure had to be cut out in order to provide clearance for the east side track connection with the yard tracks. A 75 ft. girder was installed in the place of the old column and two shorter girders which it supported. No lifting equipment was available, so that the entire operation was conducted by block and hand-jacks. The east side track connection also made necessary the entire revision of the deck at the south end of the pier and the building of several ramps to lead from the track level to the various higher levels in the adjacent sheds. It was also necessary to extend the concrete footings on six columns under the Granville Street ramp.

The entire work was done by Sydney E. Junkins & Co. of Vancouver, under the direction of Mr. J. G. Sullivan, chief engineer of the Canadian Pacific Railway Western Lines, Winnipeg, and Mr. H. Rindal, engineer, Canadian Pacific Railway, Vancouver.

Toronto Engineers Suggest Means of Increasing Prestige of the Profession

At a recent meeting of the Executive Committee of the Toronto branch of the Canadian Society of Civil Engineers a sub-committee was appointed to "study means of increasing the prestige and influence of the Toronto branch." This committee consisted of Messrs. Wynne-Roberts, Cousins, Haultain, Kerry, and Storey.

The committee has submitted a voluminous report to the executive of the branch dealing with the matter in question. Roughly, the discussion is divided under two sub-heads: (1) The relation of the branch to the community; (2) the relation of the branch to its members. Under the first heading, it is pointed out that, after all, the status of engineering can be improved, mainly by increasing its usefulness to humanity. It must be the aim of the engineer, therefore, to serve and guide the people and cultivate a healthy, vigorous, and pronounced public opinion. It is coming to be realized more and more that engineers owe it to themselves and to the country alike to accept their duties as citizens of the community in which they live, and that they should use every effort to exert influence in the legislation of the country and the administration of public affairs wherever engineering principles or practices are involved—which includes the majority of cases.

The report refers to a number of instances where engineering societies, both in Canada and the United States, have given valuable advice on engineering matters to councils, municipal authorities, and others, which has materially assisted in carrying on the affairs of the community in a more efficient manner. The committee believes that these examples are merely indicative of what such societies might do if greater attention were paid by engineers to matters of general public interest, and suggests a number of questions that might be taken up by the Canadian Society of Civil Engineers to enhance its prestige and influence.

Relation of the Branch to Its Members

The duty of a society towards its members is something more than to facilitate the acquirement and interchange of professional knowledge, though this in itself may be the primary aim. Under this heading a number of subjects are suggested which it is considered might be discussed with advantage to the members, and will doubtless form, a number of them, topics for papers for the Toronto branch at future meetings. The suggestions were as follows: The essentials of specifications; economics of bridges; rainfall and engineering; city acquisition of Toronto Street Railway; Toronto harbor works; Toronto new Union Depot; high or low railway approaches in Toronto; activated sludge process of sewage treatment; city transportation problems; city planning; aesthetic treatment of structures; problems in local improvement assessments; research in its relation to engineering; engineering and food production; valuations; engineers and conservation of life; indexing and filing of records; statutory registration of engineers; local government board for Ontario.

In addition to the intellectual side, however, the report states that the branch should consider the promotion of the professional interests of its members. As an example, it is noted that engineers are seldom put on government commissions or consulted on technical matters by the government, even when the questions involve engineering problems. This is to a very considerable extent the result of poor organization among engineers. Another point raised was the confusion in the mind of the public as to the definition of the word "engineer." "It connotes, for example, the person who plans and builds a railroad across a continent, or the person who operates the locomotive on that road. The name engineer may imply the person who designs and constructs any of the great water supply schemes and also the person who puts in the plumbing in our houses. It may refer to the chief engineer of an immense hydro-electric undertaking and also to the man who installs the wiring in a cottage. Men who design, operate, and make pumps or dredges, or heating plants, and he who designed and built the Quebec bridge, as well as the man who turns a swing bridge, are called engineers. We have civil and military engineers and engineers of all the numerous branches of modern engineering, including agricultural, forest, efficiency, and others. The divisions are so legionary and often so meaningless to the public that it is small wonder it frequently fails to appreciate what we are, or what we are doing, and in this manner our status is affected."

The report goes on to discuss whether legislative powers should be secured to restrict the practice and the title of engineer to those who measure up to certain qualifications. Toronto engineers themselves are undecided on this question. Quebec and Manitoba Provinces have such powers at present. Alberta and British Columbia are working to that end. In the United States certain steps have been taken in this direction. It is evident that legislation in such a matter must be Dominion-wide. "The experience of the medical, legal, and educational professions in this regard should afford us an excellent lesson as to the absurdity of making each province a kind of water-tight compartment in these matters."

The question of compensation is discussed at considerable length. It is pointed out that assistant engineers, for example, are paid less than many classes of non-technical men. The question of the effect of legislation requiring the licensing or registration of engineers on the amount of compensation is also touched upon, though it is not plain that this would be material. It is generally conceded that fair compensation can usually be demanded by a capable man, but the engineer's weakness is that he does not consistently and systematically make his capabilities known to the general public. The report also touches on the matter of defence, indicating the necessity of the society as a body, as well as its members individually, coming to the aid of any member when he may be unjustly attacked.

A few paragraphs are given over to the question of scientific research for the branch. The report urges its encouragement and assistance in every possible way, and concludes as follows:

"In presenting the foregoing report, on 'how to increase the prestige and influence of the branch,' we have to state that the subject is opportune and important. The branch should be the cultivated senses of the body politic. It is the principal means by which we can assert our rights, enjoy our privileges, and increase our professional standing. Neglect the functions and atrophy sets in; cultivate them and they develop in usefulness, strength, and vitality.

"We believe that the profession is destined to occupy a position of greater importance in the future life of the nation than it has ever done in the past, and that the era which is now unfolding its doors will call for loyal and efficient public service. Many of the troubles of the past have been prescribed for without making a scientific diagnosis of their causes, but in future the engineering profession will be invited—nay, compelled—to accept its duties and responsibilities in this work. The branch should constitute the strongest living organizm of the institute.

"Engineers will be able to do a great amount of work as they are now represented, but when our forces are combined, the possibilities of doing greater work will be enormously enhanced. We would cherish the hope that engineers of all branches of the profession will see the force and influence of one great Canadian engineering organization. That does not mean the submerging of various categories of engineers, but the encouragement of the progress of each, under one common flag, one common aspiration, and for one common achievement, namely, the promotion of the best in every branch of engineering for the advancement of our national prosperity, and this will assuredly rebound to our personal and professional advantage, prestige, and influence."

The Open Boat

"When this here War is done," says Dan, "and all the fightin's through,
There's some'll pal with Fritz again as they was used to do;
But **not me,"** *says Dan the sailor man,* **"not me,"** *says he*
"Lord knows its nippy in an open boat on winter nights at sea."

* * *

"When the last battle's lost an' won, an' won or lost the game,
There's some'll think no 'arm to drink with squareheads just the same;
But **not me,"** *says Dan the sailor-man, "an' if you ask me why—*
Lord knows its thirsty in an open boat when the water-breaker's dry."

* * *

"When all the bloomin' mines is swep' an' ships are sunk no more,
There's some'll set them down to eat with Germans as before;
But **not me,"** *says Dan the sailor-man,* **"not me,** *for one—*
Lord knows it's hungry in an open boat when the last biscuit's done."

* * *

"When peace is signed and treaties made an' trade begins again,
There's some'll shake a German's hand an' never see the stain;
But **not me,"** *says Dan the sailor-man,* **"not me,** *as God's on high—*
Lord knows it's bitter in an open boat to see your shipmates die."

—C. F. S. in "Punch"

Masonic Temple Building, Toronto

THE Masonic Temple Building, at the corner of Davenport Road and Yonge Street, Toronto, is complete and the various Masonic Lodges throughout the city are holding their meetings in the new building. It is a three-storey, fireproof structure with a commodious basement.

The footings and piers are of reinforced concrete, and, as will be seen in the cross-sections, some very large spread footings are used to carry the floor loads, which are largely concentrated at four points. The footing for the north wall and piers is a cantilever type and is a continuous section throughout the entire length.

The superstructure is reinforced concrete and has a number of interesting features. On studying the accompanying cuts it will be seen that the main feature is the provision for a large auditorium on the first floor; there are only two internal columns supporting the second and third floors and roof, leaving the auditorium entirely free from column supports for the ceiling. This effect was accomplished by building a reinforced concrete truss on the second floor between the two internal columns. This truss has a clear span of 67 feet and in turn carries the end load of two similar trusses which span between it and the north exterior wall, a distance of 62 ft. 6 ins. These trusses form the partitions between the various lodge rooms and between the lodge rooms and the reception room. Only the lower chords are visible in the auditorium, and they project a few inches below the slab soffit, giving the ceiling construction a very light appearance. The method of supporting the gallery load is shown on the section. A beam is located in the third riser of the stepping, which in turn carries a series of cantilever beams supporting the seat slabs.

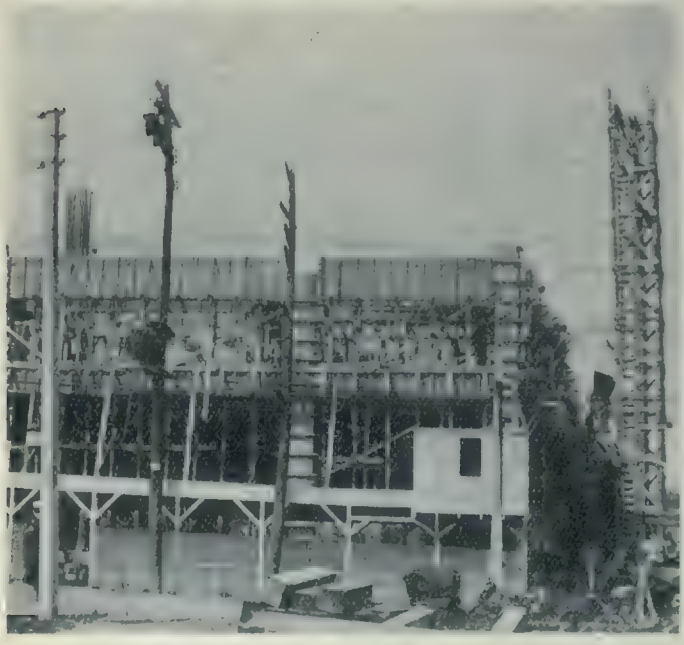


Fig. 1—The Yonge Street Masonic Temple.

The building of a long span beam of reinforced-concrete generally requires very heavy and deep construction; thus an ordinary reinforced concrete beam spanning 67 feet would project at least 6 feet below the slab soffit, and in order to accommodate the required section area of steel would have to be something over 3 feet wide. A beam with a cross section of 3 feet x 6 feet projecting below the ceiling line would, in the majority of cases, be out of the question and a lighter construction of steel would be used. The evolution of this reinforced concrete beam, in order to lighten it, has been to change the shape of the cross-section, making it deeper and narrower. The deepening of the beam increases the effective working moment the steel is able to develop with reference to the neutral axis of the beam, which means that a smaller section area of steel may be used without impairing the strength of the beam.

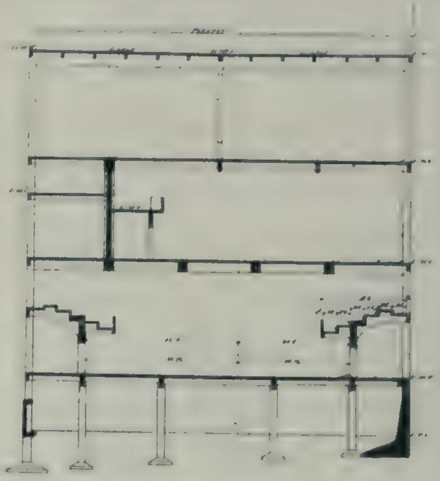


Fig. 2—Showing concrete truss on second floor.

The next logical step was to carry the beam down to the floor below and let the beam itself become a partition or truss, with the upper chord carrying the superimposed loads and the lower chord carrying the floor loads.

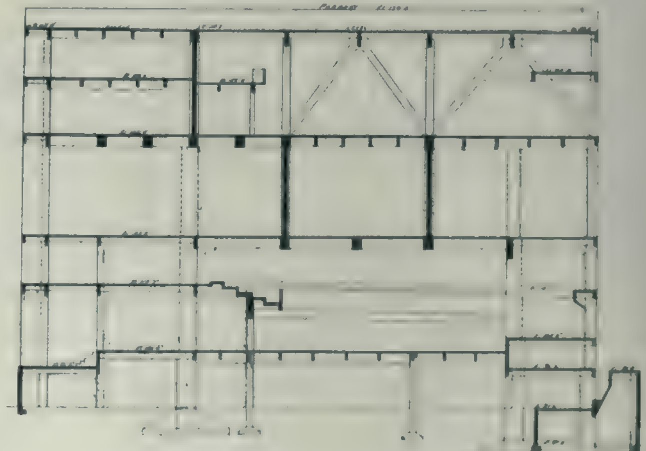


Fig. 3—Elevation looking east and west—concrete truss 67 ft. long.

Another striking example of this class of design, using the Hennebique system, was described in an article on the Trusts and Guarantee building, Toronto, which appeared in the Contract Record of September

12, 1917, Messrs. Mouchel & Partners being responsible for the design.

Large Rooms Free from Column Supports

The following accommodation is provided in the basement; banquet room, 80 x 50 ft., capable of seating 450 persons; hall, 23 x 37 ft., with lavatories, cloak room and kitchen. The boiler room is placed at a lower level and the caretaker's apartments are built over them. On the ground floor level, the foyer and retiring rooms are provided. The floor, steps and wainscotting of the vestibule and foyer are finished with Napoleon grey marble quarried in Missouri. The walls are plastered, stucco finish. The auditorium on this floor is 78 ft. 6 in. x 67 ft. with an 18 ft. gallery on three sides, and a stage 36 ft. x 16 ft. Committee rooms, offices and board rooms are placed at the gallery level. On the second floor are three lodge rooms, 34 x 62 ft., 30 x 62 ft., and 47 ft. 6 in. x 62 ft., respectively. Each lodge room is provided with a separate reception room. The third floor provides two lodge rooms, 33 ft. x 61 ft. and 38 ft. 6 in. x 61 ft., with a stage and choir gallery to each room. Pantry and banquet room, 29 ft. x 63 ft. are also placed on this floor.

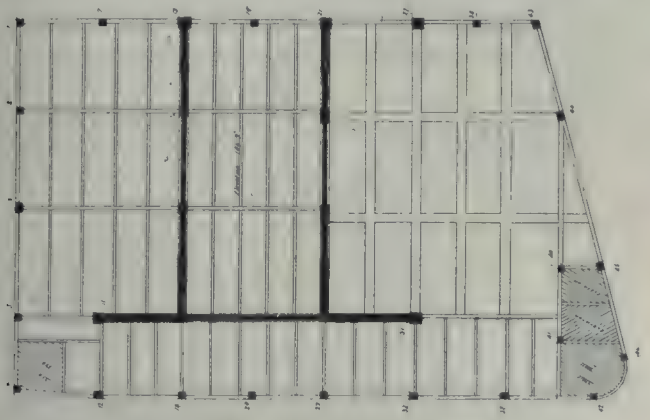


Fig. 4—Plan showing all three trusses.

The lodge rooms are all entirely free from columns and have received a very simple treatment of sand finished plaster and plain trim.

The building was designed according to the Hennibique system of reinforcing. Mr. A. C. Richmond, Yonge Street Arcade, Toronto, had the contract for the reinforced concrete work. H. N. Dancy & Sons did the masonry; Hoidge & Sons, the plastering; S. R. Hughes, the carpentry and joinery; the Gibson Marble & Granite Company supplied the marble; Messrs. Bennett & Wright installed the heating and plumbing, and Macdonald & Willson, the electric wiring.

The fourteenth convention of the American Concrete Institute, which was scheduled for last February, was postponed until June, on account of the severe traffic conditions at that time. The dates have now been decided upon, and the convention will be held June 27, 28, 29, at the Hotel Traymore, Atlantic City, N.J.

The Ontario Legislature have granted sums totalling $22,500 for colonization roads, bridges, etc., in the Fort William district. This is quite apart from the government money which will be spent by the Northern Ontario Development Company in that district.

Building Permits for March, 1918

THE value of building permits issued in 35 cities, showed a substantial increase during March as compared with the previous month, the total value of permits rising from $901,933 in February to $2,133,781 in March, an increase of $1,231,848, or 136.6 per cent. Alberta was the only province to record a decline, and large gains were made in Saskatchewan, Manitoba, Ontario and Quebec. As compared with the corresponding month of 1917, there was a decline of 13.3 per cent., the value for March, 1917, being $2,461,162. In this comparison, gains were shown in Nova Scotia, Saskatchewan, Alberta and British Columbia.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

			March, 1918, compared with March, 1917 Increase (*) Decrease (†)	
Nova Scotia	**593,426**	**587,158**	*** 56,268**	*** 7.19**
Halifax	47,768	68,475	† 20,707	† 30.24
Sydney	45,658	18,683	* 26,975	* 144.38
New Brunswick ...	**45,600**	**277,200**	**† 231,600**	**† 83.55**
Moncton	1,500	....	* 1,500	....
St. John	44,100	277,200	† 233,100	† 84.00
Quebec	**271,189**	**610,284**	**† 339.095**	**† 55.58**
Montreal-Maisonneuve	241,660	470,840	† 229,180	† 48.61
Quebec	22,329	129,699	† 107,370	† 82.78
Sherbrooke	......	5,200	† 5,200	....
Three Rivers	7,200	3,795	* 3,405	* 89.72
Westmount	......	750	† 750	....
Ontario	**1,001,599**	**1,234,520**	**† 232,831**	**† 18.86**
Brantford	8,925	13,260	† 4,335	† 32.60
Fort William	97,450	2,150	* 95,300	*4,432.56
Guelph	11,820	14,369	† 2,549	† 17.74
Hamilton	94,625	287,180	† 192,555	† 67.05
Kingston	5,660	11,040	† 5,380	† 48.73
Kitchener	14,970	15,480	† 510	† 32.95
London	29,615	46,300	† 16,685	† 36.04
Ottawa	94,470	63,175	* 31,295	* 49.52
Peterborough	3,250	4,945	† 1,695	† 34.28
Port Arthur	3,015	220,745	† 217,730	† 98.63
Stratford	1,670	11,258	† 9,588	† 85.17
St. Catharines	32,305	22,835	* 9,470	* 41.47
St. Thomas	1,975	1,170	* 805	* 68.80
Toronto	529,664	414,508	* 115,156	* 27.78
Windsor	72,285	106,115	† 33,830	† 31.88
Manitoba.	**137,902**	**159,610**	**† 21,708**	**† 13.60**
Brandon	2,252	2,060	* 192	* 9.32
Wannipeg	135,650	157,550	† 21,900	† 13.90
Saskatchewan	**459,100**	**23,300**	*** 435,800**	***1,870.39**
Moose Jaw	7,300	5,200	* 2,100	* 40.38
Regina	442,150	6,885	* 435,265	*6,321.93
Saskatoon	9,650	11,215	† 1,565	† 13.94
Alberta	**27,410**	**18,900**	*** 8,510**	*** 45.03**
Calgary	23,000	14,300	* 8,700	* 60.84
Edmonton	4,410	4,600	† 190	† 4.13
British Columbia .. .	**97,455**	**50,180**	*** 47,275**	*** 94.25**
New Westminster .	4,300	14,185	† 9,885	† 69.69
Vancouver	79,170	33,715	* 45,455	* 134.82
Victoria	13,985	2,280	* 11,705	* 513.38
Total—35 cities ..	**$2,133,781**	**$2,461,162**	**†$327,381**	**† 13.32**

Of the larger cities, Toronto and Vancouver recorded gains both as compared with February, 1918, and with March, 1917. Montreal-Maisonneuve and Winnipeg reported increases in comparison with the preceding month and declines as compared with March of last year. Of the smaller centres, Sydney, Fort William, Ottawa and Regina all showed considerable increases in both cases.

In an article which appeared in our issue of April 10, describing the constructional features of the La Loutre Dam, the wording of the credit to Mr. J. B. D'Aeth might make it appear that he was the engineer to the Quebec Streams Commission. This is not the case, as Mr. O. Lefebvre is engineer to the commission, and, as such, has complete jurisdiction over their entire work; Mr. D'Aeth is resident engineer.

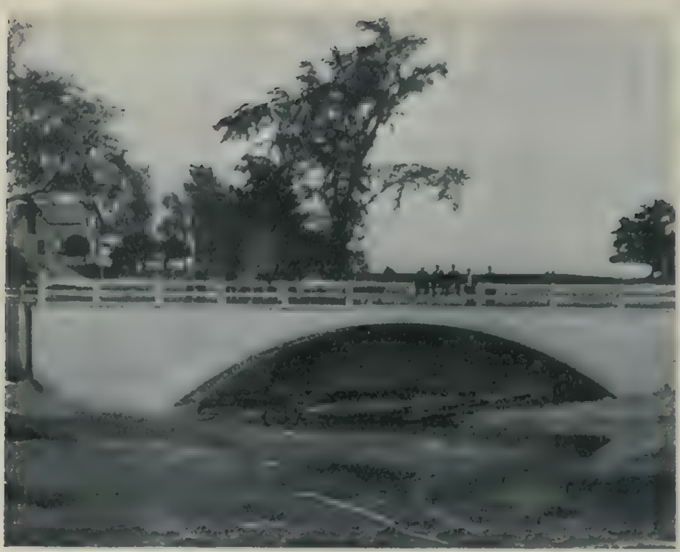


Fig. 1—60 ft. bridge in Peel Township.

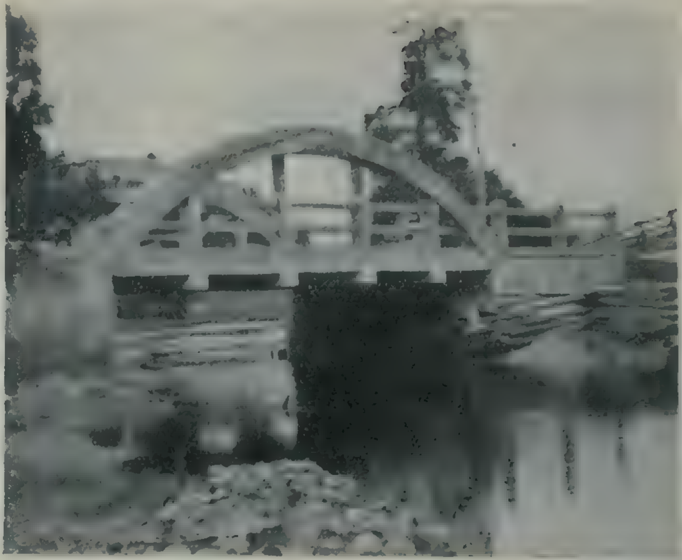


Fig. 2—Brown bridge, Mt. Forest—designed by Bowman & Connor.

Reinforced Concrete Highway Bridges

in the Province of Ontario—Some Fine Examples of Recent Work Combining Beauty and Utility

By G. Graham Reid

PROBABLY no more complicated problem presents itself to municipalities in these days than the bridges, large and small, that have to be rebuilt to replace the old temporary structures and make the highways a safe and practical means of local transportation. The widely-varied types of increasing traffic now coming on the roads and the ever-rising price of materials, especially of structural steel, have made this problem no mean one in engineering. Automobiles and motor trucks, traction engines, and such comparatively new implements of transportation and industry have to be reckoned with in designing and building highway bridges, and every location presents its own set of difficulties to the designer. To overcome these difficulties at a reasonable cost the writer has made a study of the different designs offered by engineers specializing in the design of highway bridges in Ontario.

Since 1915 the cost of structural steel has been so high that many municipalities have considered it prohibitive, and have laid over the construction of their bridges, especially those of longer span, until after the war. This the writer believes to have been a mistake in most cases, as after the war other problems will present themselves in the way of financing construction, and the municipalities will find themselves in a position at least no better, if not worse, than they were before. Moreover, an attempt has been made, and so far has been fairly successful, to suit to the needs of each and every location a design in reinforced concrete at a reasonable price. An attempt will here be made to roughly divide these locations into different types for

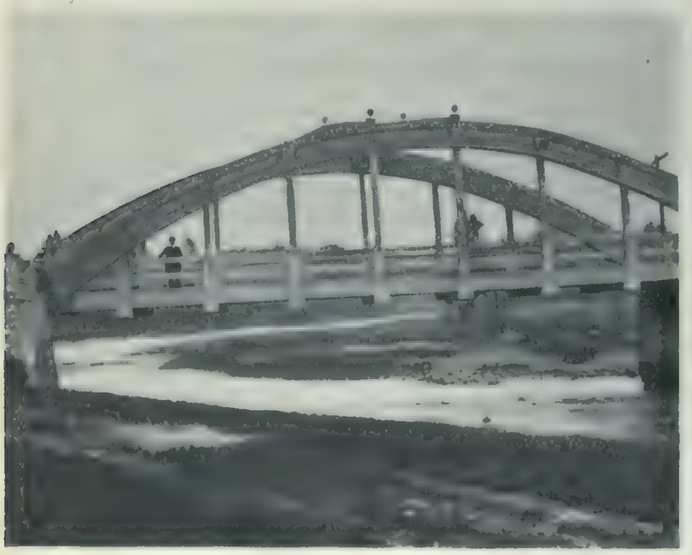


Fig. 3—Flaxmill bridge near Drayton, Ont.—designed by Bowman & Connor.

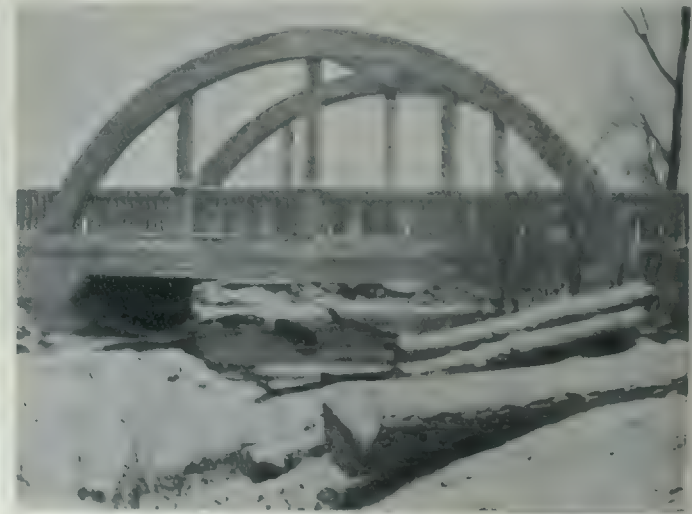


Fig. 4—Arch truss built by Ontario Bridge Co.—designed by J. G. Cameron, County Road Superintendent.

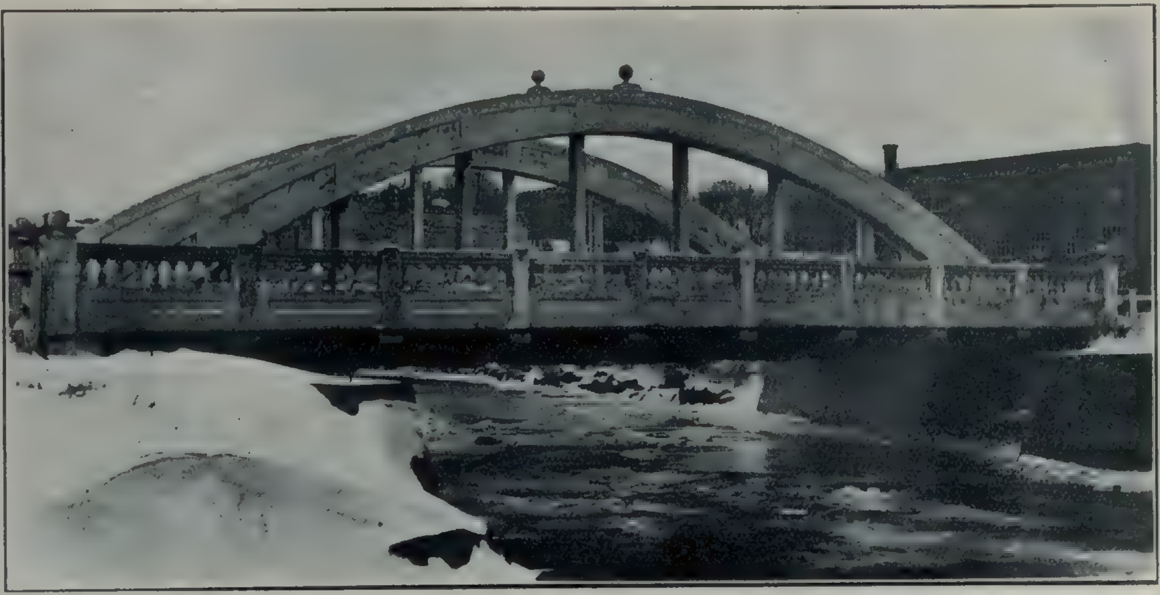


Fig. 5—Designed with sidewalk and railing—Port Hope, Ont.

the purpose of description, although this division is of very little practical use in designing the structures.

Structures for Varying Locations

There is, first, the location demanding only a comparatively short span, with plenty of head-room for flood waters. The ordinary arch, a type of which is shown in Fig. 1, is suitable for this situation, although it demands a fairly firm foundation, the footings of which should be carried well down beneath the possibility of scouring. The type of railing shown here is a simple and pleasing one, costing approximately only 60 cents per foot, and can be used on almost any type of reinforced concrete highway bridge. The wing walls are here shown extending straight back with the centre line, but these may be changed to the flaring type should it be desired for the purpose of breaking ice or turning the flow.

Should there, however, not be enough head-room for this type of construction, a beam span may be used up to spans of about 40 feet. Beyond this the depth of beam necessary to carry the load brings the head-room factor again into consideration and another design is necessary. Here, too, the wing-walls may be flared and the railing may be carried back along the edge of the approach fill by lengthening the posts, which are pre-cast and mortised to support the rails. It may be noted here that the cost of such a railing compares favorably with that of a wooden one, as it can be built

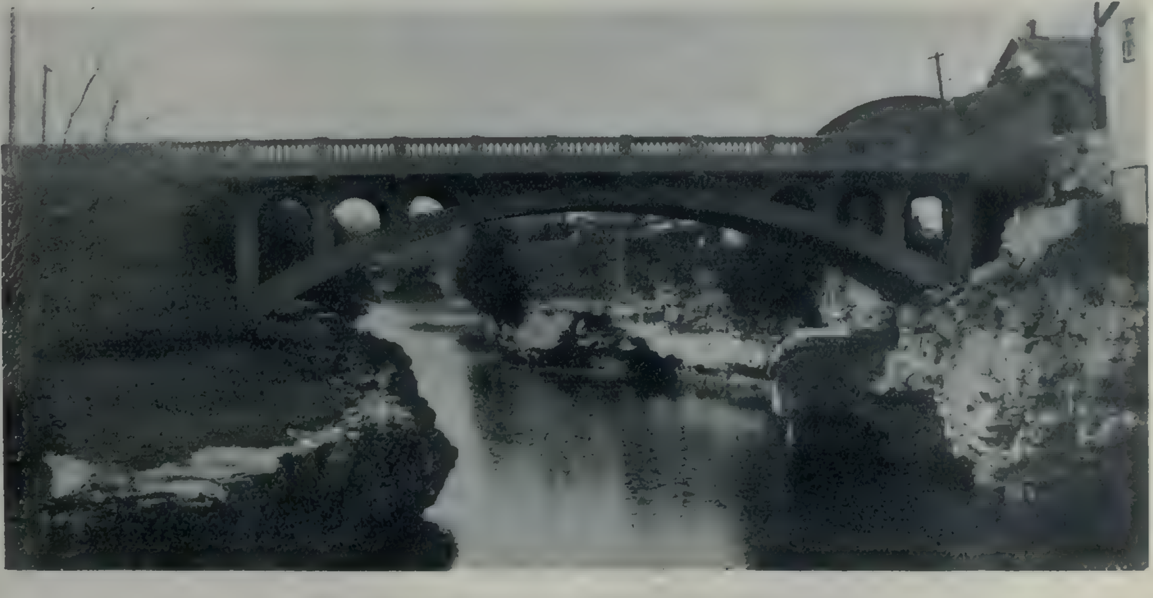


Fig. 6–80 ft. arch span, 16 ft. roadway, 2 sidewalks 4 ft. 6 in.

for about 80 cents per foot, and requires no maintenance, such as painting, repairs, etc.

Beyond the span of 40 feet a comparatively new design has been introduced, taking the place of many structures which were formerly built of structural steel. Three different designs of this type are shown on Figures 2, 3, and 4. Fig. 2 shows an arch truss of comparatively short span, built where there is very little head-room, and it will be noticed that only the depth of the floor-slab, about 8 inches, comes between the roadway and the water. Fig. 3 is a truss of longer span, one of the longest yet built in Ontario, and taking the place of a steel structure which would have cost greatly in excess of $3,500, the cost of the bridge shown, and would have required a great deal of maintenance. This bridge has been built two years, and, at present writing, shows no defects either in design or construction. It will be noticed that the same type of railing is used, and that one of the wing walls is flared to act as an ice breaker. Fig. 4 shows a span of somewhat similar construction, built in Eastern Ontario by the Ontario Bridge Company, and designed by J. G. Cameron, B.A.Sc., county engineer for Stormont, Dundas and Glengarry. The simplicity and pleasing lines of this structure are worth of notice. Fig. 5 shows a truss designed with a sidewalk and baluster railing where a more ornamental structure was desired in the town of Port Hope. It is now proposed by the designer of these bridges to use the same type on longer spans, and, where the construction of piers is possible, to use as many spans as desirable on wide crossings where head-room is limited, as it is known that there are many such locations in the province.

Fig. 6 shows the ordinary open-spandrel arch, suitable for longer spans where there is plenty of head-room. Here the open, pre-cast railing shown on Fig. 1 may be used if a simpler and cheaper structure is desired in rural districts.

Good Highway Systems Increase Efficiency

Variations of these different types the writer believes to be at least approaching a solution of the problem, although no doubt there are many important improvements that can and will be made. Reinforced concrete is the one building material that has not risen in price beyond all precedent, although the advanced price of labor has made this type of construction very much more expensive than in pre-war days. However, one cannot predict a very material decrease immediately after the war, and it is the belief of the writer that there is only one day better than to-morrow for reinforced concrete construction, and that is to-day. There is the effect of linking up our transportation systems and completing them for after-war reconstruction to be thought of, as well as the immediate value of these roads in winning the war. In all history the factor of good roads and bridges has been a great help in winning the struggles of civilization, and it is to be hoped that this will not be lost sight of in the prevailing effort to keep down the tax-rate.

Supporting Strength of Sewer Pipe in Trenches

SOME important points with reference to the supporting strengths of sewer pipe and drain tile in shallow ditches with different pipe laying methods, have been brought out by tests conducted by the Iowa Engineering Experiment Station, at Ames, Ia., during the past two years. In the first place, they have established that the "ordinary supporting strengths" (which are those developed with the "ordinary" pipe-laying method) are equal, with close approximation, to the cracking loads in laboratory tests with standard "sand" bearings; secondly, the supporting strengths developed with the "first class" pipe-laying methods may be set safely at least 20 per cent. greater than the "ordinary supporting strengths" of the same pipe; and third, it is possible to design and build concrete-cradles at reasonable cost which will increase the cracking supporting strength of sewer pipe and drain tile 100 per cent. or more above their "ordinary supporting strengths." The results of the investigations are published in a bulletin of the station, written by A. Marston, W. J. Schlick and H. F. Clemmer, extracts from which follow:

Effect of Variations in Pipe-laying Methods

It was formerly thought that the effects of differences in pipe-laying conditions upon the supporting strengths developed by sewer pipe and drain tile in ditches must be so great as to make hopeless any attempt to systematize the subject in a scientific manner. Extensive tests of sewer pipe and drain tile in recent years, however, have demonstrated conclusively that the effect of differences in pipe-laying conditions upon the supporting strengths developed in actual ditches is much smaller than had been supposed.

Data from the Ames tests show that even such extreme variations in conditions affecting the supporting strength of sewer pipe as those between distribution of the pressure at top and bottom fairly uniformly over 71 per cent. of the total diameter, through standard "sand" bearings and concentration practically on the center lines, by "three-point" bearings, affect the cracking loads only to the extent of about 30 per cent. of the "ordinary supporting strengths." Extensive data published in Bulletin 36 of the Iowa Engineering Experiment Station show the same percentage of effect on drain tile, also.

Since the effect of such extensive variations in loading conditions is so small, it is quite apparent that there is comparatively little difficulty, after all, in dividing pipe-laying conditions systematically into a small number of classes, and in ascertaining the relations of each class to the supporting strengths developed by sewer pipe and drain tile in actual ditches.

Methods of Laying Pipe Classified

The classes of pipe-laying methods frequently encountered and their relations to the supporting strengths developed by sewer pipe and drain tile in ditches are as follows:

"Impermissible" pipe-laying methods are those in which the bottom of the ditch is not suitably rounded to fit the under side of the pipe, or in which hub-holes are not properly dug, or in which the refilling material is not placed to fill all around the pipe, or in which other impermissible defects of similar general character occur. Impermissible pipe-laying methods should never be tolerated. They weaken the supporting strength of sewer pipe and drain tile very seriously.

The "ordinary" pipe-laying method is that in which the underside of the pipe is carefully bedded on soil for 60 to 90 degs. of the circumference, suitably rounding the bottom of the ditch for this purpose and digging hub holes for all pipe with hubs, and in which the pipe is surrounded by soil placed with ordinary care.

"Ordinary" pipe-laying is used extensively in constructing large tile drains under the direction of drainage engineers, and in constructing pipe sewers in villages and small cities. There are many variations in the wording of specifications for pipe-laying methods which should be classed as "ordinary," but the effect of minor variations in the method is not great upon the supporting strength developed in the ditch.

Refilling Helps Prevent Collapse of Cracked Pipe

The largest sewer pipe and drain tile show not more than 1-50 in. movement outwards of the extremities of their horizontal diameters under cracking loads, which is not enough to develop sufficient side resistance to affect the cracking load materially, even when the ditch filling is thoroughly tamped, as with "first class" pipe-laying. Nevertheless, all spaces around the pipe should be completely refilled with ditch filling material, for even untamped refilling between the sides of the pipe and the sides of the ditch is of great value in preventing the collapse of pipe sewers after they crack. Many miles of cracked pipe sewers and large tile drains are still rendering good service for this reason.

The loading conditions on sewer pipe and drain tile laid by the "ordinary" methods are closely reproduced by the standard "sand" bearings for laboratory tests of supporting strength. In fact, the standard "sand" bearings were devised after a careful study of ditch loading conditions, in an attempt to reproduce them as far as practicable. The field tests at Ames demonstrate conclusively that:

The "ordinary supporting strength" of sewer pipe and drain tile is equal, with close approximation, to the cracking load in laboratory tests with the standard "sand" bearings. The "ordinary supporting strength" is defined as the supporting strength to carry loads due to or transmitted through ditch filling which sewer pipe and drain tile will develop in actual ditches with the "ordinary" pipe-laying method.

The "ordinary supporting strength" of sewer pipe and drain tile is a very important factor, on which all calculations of supporting strength with different pipe-laying methods should be based, by the use of proper ratios, for the reason that in the great majority of cases of cracking of pipe in actual ditches the cracking occurs at loads just about equal to the "ordinary supporting strength" of the pipe which cracks. This has been demonstrated by very carefully and patiently collecting and studying the detailed data of all cases of cracking published or of which data could be collected during several years of correspondence and personal field investigation.

The "First Class" Pipe-laying Method

The "first class" pipe-laying method is that in which the underside of the pipe is very thoroughly bedded on soil for at least 90 degs. of the circumference (suitably rounding the bottom of the ditch for this purpose and digging hub holes for pipe with hubs) and the entire pipe is surrounded with thoroughly compacted soil, all under the direction of a competent inspector constantly on the work.

The "first class" pipe-laying method is extensively used in pipe sewer construction in large cities, and generally in all important pipe sewer construction carried out under an adequate, well organized and thoroughly competent engineering force. There are many variations in the wording of the specifications by different engineers, but the corresponding variations in practice produce only minor effects on the actual supporting strength of the sewer pipe and drain tile in ditches.

The use of the "first class" pipe-laying method ought to be greatly extended beyond present practice.

The supporting strength to carry loads due to or transmitted through ditch filling which sewer pipe and drain tile will develop in actual ditches with the "first class" pipe-laying method may be set safely at least 20 per cent. greater than the "ordinary supporting strength" of the same pipe.

The best engineers seem pretty well agreed that the use of concrete-cradles in pipe-laying ought to be greatly extended beyond present practice in the construction of all pipe sewers of 15 in. and larger diameters.

There is at present no generally accepted practice as to the detailed dimensions and other characteristics of concrete-cradles for pipe sewers of different diameters, and only a very few tests have been made to ascertain definitely the actual effect of any particular design of concrete-cradle, in increasing the actual supporting strength of the sewer pipe or drain tile in ditches. The designs of concrete-cradles are made by rule of thumb, and vary with the whims of the designers, between wide extremes for the same service.

The Value of the Concrete Cradle

In the field tests at Ames, Ia., of the supporting strengths of sewer pipe and drain tile in actual ditches a number of concrete-cradles of different designs have been subjected to actual test, with general results as follows:

First—It is possible to design and build concrete-cradles of reasonable cost which will increase the cracking strengths of sewer pipe and drain tile under loads due to or transmitted through ditch filling 100 per cent. or more above their "ordinary supporting strengths."

Second—Variations of the dimensions and other characteristics of concrete-cradles (for the same diameter of pipe and other conditions) affect the increase of supporting strength greatly. The real effect of variations can be ascertained reliably only by actual tests to destruction.

Third—A large amount of experimental investigation of concrete-cradles of different designs tested to destruction are necessary to determine the best designs and the real values of concrete-cradles of particular designs.

It has been suggested that the supporting strengths which sewer pipe and drain tile develop in actual ditches could be materially increased by bedding them on and completely surrounding them with tamped gravel.

Accordingly, this type of bedding was tested in an actual ditch at Ames, Ia., in 1916. The test indicated that complete gravel bedding increases the supporting strength of sewer pipe to a value somewhat higher than that for "first class" pipe-laying or say to at least 25 per cent. above "ordinary supporting strength" of the same pipe.

It is not sufficient that the average supporting strength developed by sewer pipe and drain tile in a particular ditch shall be barely equal to the loads on the pipe. Unless there is a proper excess of supporting strength over the load, those pipes which are weaker than the average will be cracked by the load and some unusual contingency may so increase the load as to crack even stronger pipe. A factor of safety is necessary for sewer pipe, just as for other engineering structures.

Safety Factor of 1½

The proper way to determine just what factor of safety is necessary in order to prevent undue danger of cracking of sewer pipe and drain tile in ditches is to make a careful study of all known cases of actual cracking in ditches, and a similar study of the detailed data of as many cases of sound pipe in ditches as practicable. The authors of the bulletin have been making such a study for about eight years, and conclude that:

A study of all known cases of cracking of sewer pipe or drain tile in actual ditches, and of the detailed data of a large number of cases of sound pipe in ditches shows that a safety factor of 1½ is both necessary and sufficient to prevent cracking.

Industrial House Planning

By J. Rawson Gardiner *

THE speeding up of all essential industries and the starting of certain new industries on account of the war has created conditions in the labor market which are causing manufacturers and other employers of labor to study more and more the question of housing for their employees.

In some cases better housing is being provided chiefly from the humanitarian point of view in order that the men may have better quarters in which to reside and not for any expected benefits to their employers. The reason with others is that it is very discouraging and doubtless a pecuniary loss to lose good men because there is no satisfactory housing accommodation ,and that unsanitary buildings sap the vitality and, therefore, the usefulness of the worker. With others, again, necessity has compelled them to build, as, in the case of new industries especially, oftentimes there is no available accommodation of any sort.

Men will sometimes put up with poor housing because they cannot obtain work elsewhere, but as soon as the demand for labor is greater than the supply so surely will the man take the job plus the good housing accommodation, and this fact is forcing the study of better housing conditions on many employers. It has usually been found that the worker provided with good sanitary, artistic quarters is more healthy—and therefore loses less time from sickness—as well as more contented—and therefore less likely to leave. To train a new man is an expensive process, and one that upsets the work in a factory, and where the working force is frequently renewed on account of poor accommodation it can readily be seen that good housing will probably prove a good investment.

The manufacturer usually considers it good policy to house his machinery and plant in a substantial building and one designed to suit the special requirements of his work, but how many are there who study the conditions under which their employees are housed? Is it not at least equally important, even from a selfish standpoint, that the worker be as well and as suitably housed as the machinery? Fortunately, the employer is beginning to realize the importance of housing conditions and its bearing on the work turned out at the factory.

The decision having been made to build, the first question to decide is what type of building to erect, as the needs vary for the different classes of labor. Labor is usually taken as being divided into four classes—skilled and unskilled and married and unmarried—and it is well to studv the requirements of these classes before starting work on any housing scheme.

The unskilled workers are oftentimes foreigners, and are not used to the comforts which are usually considered necessary by the native-born; the failure to distinguish between the needs of these two classes has been the cause of failure in many housing schemes.

The married men of the unskilled class are usually housed in terraces, with each unit containing four or five rooms. The minimum requirements should be as follows: (1) Living room, used as sitting and dining-room and kitchen; (2) bedroom for parents; (3) bedroom for male children; (4) bedroom for female children, with w.c. and sink. Fifteen feet frontage should be allowed. In large cities the tenement house is often necessary, in view of the higher price of the land, and in these each unit usually consists of three to five rooms, with w.c. and sink.

The married men of the skilled class are usually provided with detached or semi-detached cottages

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* Architect, 241 Beaver Hall Hill, Montreal.

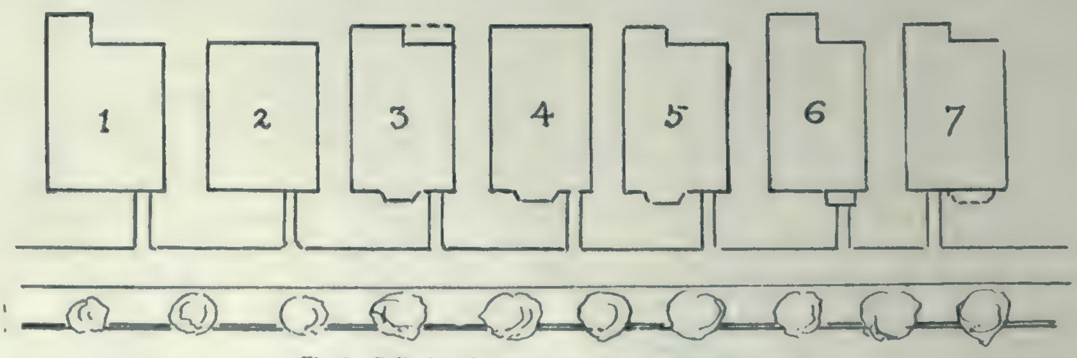

Fig. 1.—Relieving the monotony of rows of single houses.

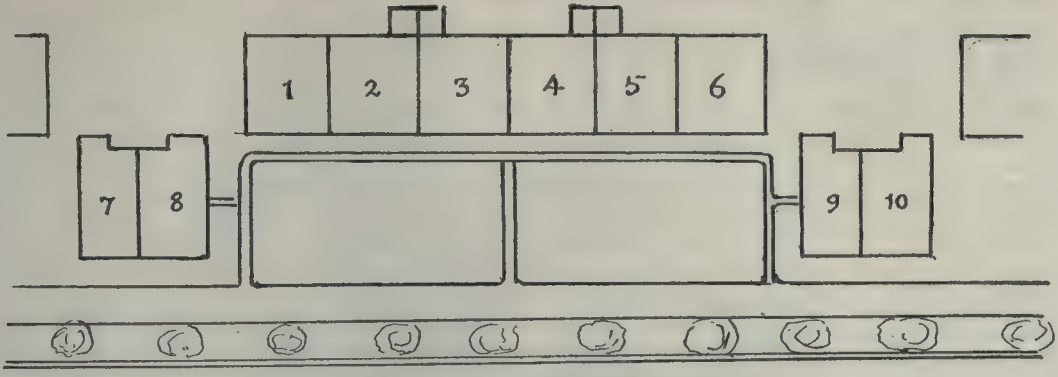

Fig. 2.—"The curse of uniformity" replaced by Courts.

wherever cost permits. These cottages generally contain from five to seven rooms, and have bathroom (bath, basin, and w.c.), sink, and washtubs.

The unmarried men of the unskilled class are generally accommodated in a boarding house kept by one of the married men. Twelve to sixteen men are sufficient for one house, and as two men are commonly placed in a room, there will be required six to eight bedrooms and a large bathroom upstairs, and dining-room, large kitchen, separate living room, bedrooms, and bath for the family keeping the establishment, on the ground floor.

The unmarried men of the skilled class require a boarding house of, say, eight to ten bedrooms, with one bed in each room, and at least two bathrooms, and a sitting-room as well as a dining-room, kitchen, etc., as above.

It has generally been conceded that the rental should not exceed 25 per cent. of the workingman's wage; that is, if a man earns $15 a week, he should not pay more than $15 a month as rent, or $180 a year. On this basis, calculating 10 per cent. as a fair gross return on a housing investment, the house should not cost more than $1,800, and it is plain that no superfluous space or angles or architectural detail can be given, and that every possible curtailment must be made to keep the cost within these figures. Two and one-half times the annual pay roll will, on this basis, be the capital expenditure necessary for housing the employees.

The great drawback in designing workmen's houses has been the difficulty in obtaining individualism and an artistic effect to a block of buildings when the units are more or less alike, but "the curse of uniformity" with small units has been overcome in many cases by the simple expedient of placing blocks of houses in the form of courts of different proportions. We see in many United States industrial towns the disastrous effect of the monotonous repetition of single houses in a row of more or less similar design, with the fronts all in a line and only a small, narrow space between each house. The crudeness and monotony of such treatment is disastrous from an architectural point of view, and when one considers how easily it may be obviated it seems extraordinary that it has been used so often. This may be seen by referring to Fig. 1.

Change this to the courtyard plan, somewhat as shown at Figures 2 or 3 (and the possible variations are innumerable) and one can see at once the difference —homes instead of housing accommodation. The cost is no greater, but the effect is pleasing, and one obtains a feeling of individuality and charm that must be of benefit to all concerned.

The efficiency of a plant depends largely upon the health and comfort of the workers and the health and comfort of the worker depends largely upon the housing conditions. It is, therefore, to the benefit of the employer to see that his employees are well housed, as the output of a factory may be seriously curtained by ill-health and low vitality among the workers.

The St. John Dry Dock and Shipbuilding Company has requested the New Brunswick Government to assist the company's enterprise, which includes a drydock. The proposal is to take over the partially constructed dock at Courtenay Bay and enlarge it to a length of 1,150 feet.

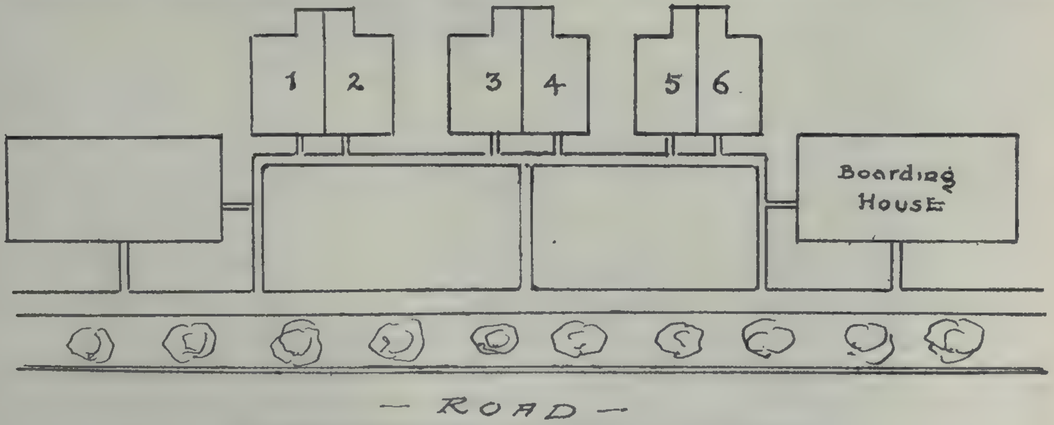

Fig. 3.—An attractive form of court design for workmen's homes.

The Application of Education to Industry

An Address Delivered before the Annual Meeting of the Joint Committee of Technical Organizations, Ontario Branch

By Col. David Carnegie*

Before referring particularly to the subject I have chosen for consideration this evening, I think you will be interested to know that since the formation of the Inventions Committee of the Imperial Munitions Board in February, 1917, we have examined approximately 500 proposals, sent from all parts of Canada and other countries. The following gives the number of proposals from each province in Canada and from other countries:

Inventions, March 19, 1918—Total Proposals Received to Date, 543

Ontario	223
Quebec	46
Manitoba	12
Saskatchewan	30
Alberta	27
British Columbia	28
New Brunswick	6
Nova Scotia	22
Prince Edward Island	2
Newfoundland	1
Yukon	1
United States	129
England	4
Australia	1
New Zealand	1
France	2

Out of these we have forwarded 32 proposals to the Inventions Board in London.

One inventor sent as many as eight different inventions. The proposals have related to aeroplanes, protection of ships from submarines, designs of guns, shells, bombs, aerial torpedoes, tanks, and many other minor warlike subjects. Prior to the formation of our committee inventors knew of no particular department of government where to send their proposals for consideration, and no particular department had any specific organization formed to examine carefully the proposals submitted. We have on our committee representative members of the military and naval services of the Government of Canada, the universities, and technical societies, all of whom are voluntary workers. We have also the assistance of the Patents Office staff and other departmental branches of the Dominion Government where the proposals submitted require the investigation of specialists in their departments.

We think that the work of the Inventions Committee, although it has taken very little time from the regular duties of the officers of the Imperial Munitions Board, has served a very important purpose, and has awakened and developed many latent faculties. Evidence of genius has been marked, but the need for its direction and instruction in the elementary principles of science have been revealed in many of the proposals. It is because I believe that your society, consisting of technically trained men coming from different industrial centres in Canada, can be of great service in educating and directing the untutored that I have ventured to offer to you this evening some suggestions regarding the education of the industrial worker, the skeleton of which I presented to the members of the Canadian Mining Institute recently when dealing with "Some Problems in the Readjustment of Industry." I wish, therefore, to confine my remarks this evening to the functions of the educational committees of production boards for each industry, or of any other body organized with the same object.

The Functions of Educational Committees of Production Boards

In the address to which I have referred I suggested the formation of production boards for each industry, consisting of equal numbers of the representatives of the employers and employees in the district. The functions of these boards included, among other important duties, the education of industrial workers, as follows:

1. The vocational training of the child in preparation for his entry into industry.
2. The education of the actual producer (principally manual).
3. The education of the directors of production (both manual and technical).
4. The education of the distributors of production (principally financial and commercial.)

It might be advisable to look at the fundamental principles underlying industrial education before considering what might be the best kind of education.

Fundamental Principles Underlying Industrial and Technical Education for Each of the Classes Enumerated

The question might be asked: What is the object of our pursuits? Are we simply setting out to train humanity from childhood to become efficient producers in the world of industry? This would, indeed, be a worthy aim. Organized education in industry is surely better than systemless education and chaos. But that is surely not the only, or principal, object. I believe with Ruskin that "The entire object of true education is to make people not merely do the right things, but enjoy the right things; not merely industrious, but to love industry; not merely to learn, but to love knowledge; not merely pure, but to love purity; not merely just, but to hunger and thirst after justice." I am sure you will agree with me that these objects should underlie industrial and technical education, as well as every phase of education. It is not merely sufficient to turn out well-equipped and efficient workers in every class of industry most fitted to their natural bents, but to seek to make each worker discover the wholesomeness and happiness in the performance of every task, interpreting his experience in terms of pleasurable duty, which will bring not only personal gain, but will add to the interests of the community and nation. "No pleasure," says Bacon, "is comparable to the standing upon the vantage ground of truth." The great fundamental principle, therefore, underlying all education is truth—"truth in the inward parts."

Classes to Be Educated in Industry

Considering, then, the education of the human forces in industry we have: (1) The juvenile at school and at work; (2) the adult worker; (3) the director of production; (4) the distributor of production.

I wonder if a fifth class should be included—a class to provide the program of education? It is conceivable that our teachers may have misinterpreted the true fundamental principles underlying industrial education. It may even be necessary to break the moulds in which our teachers have been cast. In the light of present knowledge, I do not agree with Emerson when he says in that beautiful essay on compensation: "There is a crack in everything God has made," but if the exhibition of savagery in Europe for the past three and a half years is the outcome of the highest culture in science and arc, surely science and art have been prostituted to fiendish uses, or we are misguided in our interpretation of experience and the lessons learned therefrom, and there must be more than a crack in our man-made culture.

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Are Our Standards and Goals Right?

If the world's higher education in the intellectual and industrial pursuits has led the people into such inhuman strife, is it unreasonable to suggest that we pause and consider whether anything is wrong with our standards and measures, or is all this slaughter the outcome of their wrong uses? Have we been listening to false prophets about the glory of that land which will be plowed by the most efficient machinery; where the labor of sowing and reaping will be reduced to a minimum? Do we see before us a culture and genius which will transform with a minimum of effort the raw materials of the earth's surface, bringing with them a wealth and ease which our tired bodies and hungry souls long for? Have we yet discovered that "man shall not live by bread alone"? Are we lowering the standard of manhood by the kind of goals we have set ourselves? There are other goals beyond the gold fields; beyond the money values of industry. If "man's chief end is to glorify God and enjoy Him forever," then our standards of culture which lead us from that end are unholy. All the cruelty, intrigue, disloyalty, and avarice, so rampant in the world, and particularly in cultured Germany, indicate a self-inflicted deformity of God's image, which it was man's proud fortune to possess. If the horrors of war are arresting our thinkers and opening new vistas of unexplored mind where spirit values instead of material values count in the true adjustment of our industrial affairs, there shall evolve from the carnage and scientific barbarism a new era in which a true interpretation of the loathesome experiences through which we have passed will bring out the value of the fundamental principles upon which our industrial education must be built. We shall then discover the principle underlying education which will give the worker the opportunity of maintaining efficient service with a maximum of enjoyment.

Ability and Interest Essential to Efficiency

In the suggestions I am about to make I recognize the futility of obtaining sustained, efficient service from any class of worker, either by hand or brain, unless the worker has discovered a pleasure and interest in his employment. I believe that the co-operation of these two great human forces—ability and interest—are absolutely essential to effective service.

1. Vocational Training of Children for Industry

For the past four years there has lain upon the shelves of Canada's bookcases one of the most comprehensive reports ever made upon industrial training and technical education. I could not refer any educational committee of production boards or similar organizations to better plans for their consideration than those recorded therein. Dr. Robertson, who was the chairman of the commission appointed by the Dominion Government to investigate the scope and nature of industrial training and technical education in Europe and America did not only record the facts and make recommendations to the Dominion Government concerning their application to Canada, but has never lost an opportunity of emphasizing the need of puting the recommendations of the commission into practical operation.

The People of Canada Desire Industrial and Technical Education

Dr. Robertson's report says that Canada does not only require such education, but longs for it. One thousand, four hundred and seventy-one men and women in Canada, representing the industrial, business, agricultural, home-making, and technical work of the Dominion, witnessed to the commission their anxiety to have better industrial and technical education for Canada.

Benefit of Vocational Training in Other Countries

Dr. Robertson's report also shows that great advancement has been made in industry in England, Scotland, Ireland, Denmark, France, Germany, Switzerland, and the United States by the addition to elementary education of manual training, domestic science, nature study, and school gardens. Children leaving school at 3 or 14 years of age are transferred at the age of 11 or 12 years to classes having what is called an industrial bias, commercial bias, and housekeeping bias, where a definite time is set aside for such education. Trades are not taught at such schools, neither do these classes displace general education from books. They are known as "elementary courses,' 'and have developed at an extraordinary rate in England and Europe. In Scotland, for instance, ten years prior to the war there were 162 schools, with 3,281 pupils, and in 1913 there were 1,945 such schools, with an attendance of 43,281 pupils.

Dr. Robertson's Proposal Has Provided a Program

It is not my object now to propose any detailed program for the vocational training of the child. My object, rather, at present, is to point to the source of information where well-considered thought has been given already to the subject, and to seek to indicate how the application of such plans to each industry could be established by the aid and harmonious co-operation of the producers in each industry and the educational authorities.

Co-operation of Educational Committees and School Authorities

The Educational Committee of the Production Boards, for instance, could work in the closest association with the management committee of the school authorities of each district, with a view to the selection and preparatory training of the children required periodically for each industry. Such selection would be made having in mind always the aptitude and interest of the child in the class of work to be followed. I am informed that in connection with the examination of school children in Australia phrenologists are employed by the government to discover the direction of their bent for industry.

By the co-operation of educational committees of production boards with the school authorities they could determine:

1. The nature and duration of training most suitable for boys and girls in the schools.
2. What partial attendance at schools and works was necessary during the earlier stages of industrial training.
3. The number of hours for study, manual labor, and recreation.

Duties of Educational Committees

The duties of the educational committees of production boards would also include the preparation of the courses of training in the works for juveniles; the number of hours for such training; periodic examinations, with a view to discovering progress in interest and enjoyment in the work as well as ability; the issue of certificates showing the standard attained in the particular branch of the industry; the consideration of rates of remuneration for each child during the period of training, and also the provision of suitable conditions for the welfare of the children.

2. The Education of the Actual Producers

Although it has been said frequently that there is little hope of educating more than an insignificant percentage of the large number of men and women once they have drifted out of boyhood and girlhood, there are many signs which encourage the hope that not an insignificant percentage of the workers are craving for knowledge and right leadership. Educational authorities have done a great work in providing continuation classes for general training in industry and in arranging classes for special study relating to classified industries.

Technical Instruction in Works

These advantages are emphasized in the report of Dr. Robertson, to which I have already referred. They could be supplemented by making provision for the instruction of adults in districts where no schools exist, by the formation of classes for instruction by qualified teachers, many of whom could be found in the ranks of the industries over which production boards preside. Many of the foremen, superintendents, draftsmen and chemists could give manual and technical education in the tending of machines, the use of gauges, moulding, plumbing, blacksmithing, drawing, chemistry, etc. Certificates of qualification could be issued after a definite period of instruction and proved ability and interest. Such classes could be made so attractive that all branches of labor would be encouraged to qualify for a higher grade. The shop or yard sweeper, for instance, would have the chance of qualifying for any position requiring the highest skill in operating.

Workers' Educational Association

Perhaps the most encouraging sign of educational progress of recent years is the great movement begun by the workers themselves for the education of the adult worker, and known as the "Workers' Educational Association." It was founded in 1903 in England by a group of trade unionists, co-operative, friendly, and educational societies, and aimed "at nothing less than the restoration of education to its rightful place among the great spiritual forces of the community."

This association, pioneered by the industrial workers, joined hands in 1907 with the universities at a national conference which was held at Oxford, where seven representatives from the universities and seven from the representatives of labor formed themselves into a joint committee for the establishment of what is known as the "University Tutorial Class System." Every university in England to-day has its joint committee for tutorial class work, consisting of an equal number of university and working class representatives. A great alliance, therefore, has been formed between the sources of education and the organized working classes.

The story of the development of this work is most entrancing. In 1914 there were 2,555 affiliated societies, scattered over England and Wales. I believe that the educational committees of production boards would be able to obtain considerable help from the study of operations of the W. E. A. to enable them to formulate plans for classified education, particularly in districts where technical schools were not available.

3. Practical Training of Adult Labor

Many facilities during recent years have been offered to the adult worker in industry to improve his practical knowledge of his craft. Quite recently I received a description of a training school for employees, organized by the Recording and Computing Machine Company, of Dayton, Ohio. It had for its object the training of raw labor, men and women, to work to the closest requirements in precision work, the limits running as low as five ten-thousands of an inch. The works manager, Mr. U. Carpenter, had found that the method of introducing workers into factories and placing them on machines to learn their operation by the assistance of shop foremen and fellow-workers was not only costly but imperfect. The method adopted to overcome this common form of training was by having all the workers trained in a well-lighted room away from the factory, upon the kind of machines they were afterwards to operate in the large works. A few days', or sometimes weeks', training, by special teachers, qualified them to go into the works and operate machines without having any assistance from their fellow-operators, the foreman or leading hands in the factory.

Remarkable Advantages from Practical Training

Mr. Carpenter states that "in January, 1916, the average production of 31 women employees was eight pieces per hour." While operatives were apparently busy with this rate of production, my experiments showed that there should be produced from these machines, as a fair production, an average of 35 pieces per hour. We put our old operatives into the training department and within four weeks after the new and old operatives had been through this training department the average production was raised to over 35 pieces per hour, and to-day (January, 1918) the average is over 55 pieces per hour. The same results were obtained on all our work, such as machining, inspection, and assembling." These facts from actual experience confirm the opinions and recommendations of advocates of industrial training, and are sufficient to demonstrate the value of specific practical training. They also confirm the great possibilities of organized methods of labor, and show where work can be enjoyed while skill and output are increased.

Training and Examination of Adult Labor

The functions of the educational committee of production boards would include the classification of labor for such practical training and the direction of both men and women to the pursuit of higher grades of practical knowledge in the industry. Training courses, examinations, and certificates would be given, as in the case of juvenile workers.

3. Technical Training for Directors of Production

On first thought, the technical training for directors of production might appear unnecessary. Why should the director of production hold such a position in industry if not fully qualified, and, if fully qualified, why should educational training be necessary?

On reflection we are reminded of the technical facilities which are within the reach of directors of production who are helped by the technical press—patent office literature, proceedings from various institutions, reports of commissions and other organizations engaged in research and investigation for the solution of problems in industry.

Directors of production recognize that their education does not cease with their promotion to such positions, but rather the necessity of education increases. Much of that education which has to be secured outside the ordinary factory hours must be in tabloid or concentrated form. The real problem is to know how to place facilities for such education within their reach without overloading them with unnecessary information pertaining to other industries than their own.

Valuable Sources of Education Locked Up

In addition to the foregoing sources of information facilities are always available at the various universities and technical schools for evening study during the winter months. Lectures also are given at different institutions through which knowledge is imparted to directors of production, but it seems to me that the sources of concentrated technical education which ought to be of the greatest service to industry are locked up in volumes in different departments of the government—volumes the existence of which is not even known to the directors of production in industry.

There are, for instance, numerous volumes already issued by the Mines Branch, giving account of minerals, metals, fuels, and refractories, all of which are of vital importance to industry. In addition to these there are valuable reports issued by the Commission of Conservation, on questions of the utilization of Canada's resources, reports dealing with minerals, fuels, fisheries, game, animals, forests, lands, public health, waters, and water-powers, town planning, etc., information gathered by eminent men qualified to deal with the subject. There are also most valuable reports made by the

Department of Agriculture, the Department of Trade and Commerce, the Department of Labor, and other departments of government which would put industry under a deep obligation to the Dominion Government if they had the opportunity of utilizing the information contained in them. But, I ask, what is the value of all these records of industry? What percentage of men directing industry, such as manager, superintendents, chemists, and foremen, have ever heard of these valuable reports which minute investigation and much toil have made possible.

It has been my good fortune to have the opportunity of referring to many of these reports, and my regret has been that time would not allow of greater reference to them than was actually necessary in the prosecution of war work.

Central Authority for Classifying and Distributing Information

I cannot, however, believe that the task of wisely classifying for and distributing the results of those investigations to industry, through production boards or any other medium organized for this purpose, would be insuperable. I believe that special classification of information relating to problems and processes for each industry, together with the distribution of such information, could be undertaken by a central authority capable of dealing with the technical problems of industry as a whole. Such a central authority would not only become the principal body through which such knowledge would be imparted, but directors of industry would involuntarily turn to such an agency for assistance when in trouble.

Co-operation and Co-ordination of Sources of Information

If I were to venture to suggest for consideration a plan whereby the most efficient service could be rendered to industry through its directors of industry I would propose a union of the educational committees of production boards of each industry with the Industrial Research Advisory Council of the Government, or some similar institution which would have the authority to advise as to the use of all the technical educational sources of the country for the development of industrial research.

The value of such a union would be in the assurance of industry, through its production boards, receiving technical help and advice from the Industrial Research Advisory Council. With such co-operation and the co-ordination of the valuable technical departments of the government, universities, technical schools, and other institutions for industrial research, one can hardly estimate the value of such help to industry. Such co-ordination, in my opinion, is possible without any one of the institutions losing its identity or control. It might be necessary to re-arrange and classify the work of some of the institutions in certain respects, but such re-arrangement could be made after mature consideration.

Advantages Arising from Co-operation

Some of the advantages resulting from such a central authority as the Advisory Research Council would be as follows:

1. The classification of all information coming from the technical press, proceedings of institutions, reports of commissions, etc., suitable for the use of each industry, and distributing such information to the production boards concerned in each district. Such information could be supplemented with any observations and advice which in the opinion of the committees appointed by the Research Council would be of technical value to the industry concerned.

2. In addition to this source of information periodic conferences with directors of production in each industry could be arranged whereby discussions upon special processes or inventions could be held, with a view to the improvement of methods which would accelerate production.

3. Further, all information relating to standards of measurement, specifications for material, and standardization of processes would be supplied through the Industrial Research Council—in fact, the co-relation of the various departments with the valuable facilities for research in them could form the basis of an institution such as the Bureau of Standards at Washington and the National Research Laboratory, London, England, having committees for investigation and research in all technical matters relating to each industry.

In addition to this affiliation the production boards of each industry might be linked with the universities or technical schools of the district, so that in co-operation with the educational authorities facilities could be provided for the training of directors of production. To be afforded the privilege of using the various laboratories of the universities, colleges, and technical schools for experimental work which could not be carried out in the works of the individual manufacturer would be of great service to industry.

While I have referred particularly to Canada and her educational institutions which could be linked with organized industry, the same suggestions apply to the institutions and industries of Britain and other foreign countries.

Constitution of Central Authority

With regard to the constitution of such a central council for research the present body might wisely be enlarged to include the heads of such departments of the government now conducting research in different lines of industry. It might also be advisable to make the head of each technical department chairman of the section of the council's work relating to the operation of the government department over which he presides.

I believe the constituted machinery of the government, which has done admirable service in the past, with an efficiency which has been seldom recognized or fully appreciated, only remains to be geared up to some such central authority to make each department of the fullest value to the nation through the nation's industry.

4. The Education of Distributors of Production

We have, in conclusion, to consider the education of a class of workers who cover perhaps a wider field of operations as distributors of production than even the directors of production. They are not only concerned in recording statistics, accounting, and costing in relation to production, but in the distribution of products, involving shipping, railroading, and other means of distributing products—subjects in themselves which form a most important part of the problems of factory administration.

The work of the educational committee of a production board would include in a general way the consideration of the best systems of commercial training suitable for all branches of a factory's office staff, but there are, in addition, larger questions, which involve finance, accounts, costs, commercial law, the systematic study and familiar knowledge of which are essential if industry is to be established on an enduring foundation.

By linking the educational committees with the educational authorities whose institutions make a special study of this phase of educational work, plans could be more readily formulated for the education of distributors of production in every kind of development in commercial industry.

The Appointment of Advisory Council on Finance and Commerce

It might be found advisable to appoint a government industrial central financial and commercial advisory body of a nature and standing similar to that of the Industrial Research Council, but having for its object the classification of all matters of finance and commerce common or particular to each industry, and the distribution of such information as would admit of the standardization of methods for educational development in factory administration, accounting, costing, commercial law, transportation, and all other matters relating to the interchange of production between buyers and sellers.

Such a council might consist of representatives of the leading financial institutions in the country, representatives of universities dealing with political economy and commercial training, representatives selected from the administrative side of large business houses, representatives from the institutions of accounting, representatives from the shipping and railroading companies, and representatives of the various government departments, such as customs, trade and commerce, finance, labor, etc. The objects, formation, and value of such a council to industry are worthy of the most careful consideration.

Gentlemen, I believe you are all ready and able to take your part in the education of the industrial worker, and I hope your society may give consideration to the proposals I have made.

Mainly Constructional

East and West—From Coast to Coast

The Wentworth County Council have voted $25,000 for road work this year. The estimates of the road superintendent amounted to $36,000.

The Cape Breton Shipbuilding Company, Ltd., has recently been incorporated, and has secured a shipyard at Johnstown, in Richmond County. The enterprise is promoted by local men.

The Fraser Company, Ltd., have been rushing work on their dam over the Madawaska River at Edmundston, N.B., before the rise of water when the ice runs out. Work is expected to be finished early in the summer.

The Agricultural Cement Tile and Drainage Company, Ltd., has been incorporated, with a capital of $25,000; head office at the village of Vaudreuil Station, in the Province of Quebec.

The loss to the buildings and equipment of the Harris Abattoir, West Toronto ,through the recent fire, is estimated at $1,000,000, covered by insurance. Reconstruction will be started within a few days, according to statements of the company's officials.

The road commissioner of Essex County, Ont., Mr. E. J. O'Neil, has placed his estimate for this year's road work at $47,501. The county's share of this amount is $27,868, and the balance, $19,632, will be contributed by the provincial government and the city of Windsor.

McArthur's bridge, over the Sauble River, in East Williams Township, Ont., collapsed recently. The bridge was one of the largest of the old wooden bridges remaining in that district, consisting of two spans, each 35 feet long. It is supposed that the spring floods undermined the piling.

The owners of 2,700 feet of frontage on the west side of Yonge Street, between Christ Church and the Toronto city limits have consented to donate a strip of land 10 feet wide for the entire distance provided the other owners will do likewise and that the city will carry out the proposed widening scheme.

At a recent meeting of the Council of South Vancouver a resolution was passed asking the government to empower the Vancouver and Districts Joint Sewerage Board to complete the big sewer main just west of Central Park, which would drain about 400 acres of Burnaby land which now sheds into South Vancouver, causing considerable trouble to residents in that district.

The Surrey Dyking Commission recently decided to call tenders for the completion of the Surrey Dyking Scheme. The main portion of the construction work—that of erecting two concrete dams in the Nicomekl and Serpentine flats, was completed in 1913, at a cost of $135,000. The building of the road dyke between the dam and the hill, which had been left in abeyance, is now to be undertaken.

The tender of E. W. Edge, Ltd., Ottawa, for the heating and ventilating equipment for the new parliament buildings at Ottawa has been accepted. Their figure, at $386,000, was the lowest submitted, all others exceeding $400,000. McFarlane-Douglass were the successful tenderers for the bronze-covered frames and sash, at $32,500, and the Otis-Fensom Elevator Company got the contract for equipment for two elevators, at $31,940.

The British-American Nickel Refining Company, which has been negotiating for property on which to erect a refining plant for some time, has decided to locate on the Hull side of the Ottawa River. It is said that the company have purchased the property known as the old Conroy piling grounds at Deschenes, upon which a nickel refinery, to cost in the neighborhood of $1,000,000, will be erected. Construction work is to start shortly.

The Board of Trade of Brantford, Ont., have decided to form a company, under the auspices of the board, for the erection of 100 workingmen's houses in that city this summer. This action is being taken on account of the great scarcity of houses in Brantford at present. The plan is to provide funds for the building of a standard type of house and the sale of the same on the installment plan. Some $100,000 has already been offered for the carrying out of the project.

The D. W. Mitchell Construction Company, of Toronto, have submitted a proposal to the city of Hamilton, Ont., regardng the erection of a mausoleum. The company would build a mausoleum, at a cost of $100,000, and would guarantee to sell sufficient crypts to cover the cost of construction before commencing operations. They would charge 15 per cent. commission for selling these crypts and another 15 per cent. for preparing the plans and specifications and supervising the construction of such an edifice. The cemetery board is considering the proposition.

The Welland County Council have received notice that at the next session of parliaentm application will be made for an act to incorporate the Canadian Niagara Bridge Company with power to construct, maintain, and operate a railway and general traffic bridge across the Niagara River, with necessary or proper approaches and terminal facilities, from some point in the Township of Bertie or in the Township of Willoughby, in the County of Welland, and to charge tolls for the passage of engines, cars, vehicles, foot passengers, and general traffic over the bridge approaches and terminal property or over the yard thereof. The communication was received from Cabell & Soule, of Hamilton, solicitors for the applicants.

The Township of Malahide, Ont., has a difficult problem confronting it in connection with the opening of the highway known as the First Concession of Malahide, which has been closed for a considerable period on account of a heavy freshet in June, 1916, washing away the foundation of the steel bridge over the Stalter gully. To build a new structure would cost probably $25,000 or $30,000, and Mr. Hogarth, engineer of the Ontario Highways Department, who was called into consultation ,advised, after going over the district, that it would be unwise to erect any bridge at the Stalter gully when another gully, which in a few short years will be as big as the Stalter, is working its way north from the lake. This latter gully, if not checked, will no doubt cross the road, completely isolating any bridge that might be built across the Stalter. Some of the property-owners are agitating for the opening of the road, and the township council find themselves in a difficult position.

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Can. Soc. Civil Engineers becomes Engineering Institute of Canada

THE Bill for changing the name of the Canadian Society of Civil Engineers to that of the Engineering Institute of Canada has passed the House of Commons without amendment, and has been sent to the Senate. In the House or Commons the Bill was sponsored by Sir Herbert B. Ames and in the Senate by Senator Casgrain.

This Act of the Dominion Parliament marks the climax of an agitation that has been under way for many years. When the Canadian Society of Civil Engineers was formed it was the intention that **all** engineers be included; in those days the word "civil" in the popular mind encompassed, so to speak, all the subdivisions of engineering. But times have changed and with it the meaning of words. To-day branches of engineering that were insignificant in the old days have assumed gigantic proportions—e.g., electrical engineering—and in consequence we have come to look upon "civil" engineering and "electrical" engineering as two fairly distinct, though closely related, branches of the one great family of "engineering." The same is true in more or less degree of mining, mechanical and chemical engineering—and others possibly will follow. It is seen, then, that whatever the original conception of the word "civil" may have been and whatever scope it was intended the society should cover, developments of the intervening years have altered our viewpoint and made it necessary (1) either to change the name of the society so as to make it as comprehensive as was originally intended or (2) deliberately narrow the scope under the existing name.

It is indicative of the careful study that has been given to the question that the decision was kept in abeyance for so many years after the agitation started. It is also indicative surely of the overwhelming arguments in favor of the change that the oppositionists so long in evidence have not only consented to remain inactive but, in most cases, have indicated their approval and are giving the society, under its new name, their heartiest support.

It remains now to be seen whether the change was made too late. It is probably not yet fully realized by the various other organizations that the door is now standing ajar where formerly it was, in their opinion, shut and locked. It is probable that the changes in the constitution of the C. S. C. E. are not very clearly understood by engineers who are not members of that society. That being the case, it would apparently be one of the first duties of Secretary Keith to start a campaign of publicity designed to reach every engineer and technical man in the Dominion who has not been directly in touch with the recent changes. Quite aside from existing organizations there is a very large number of engineers in the various provinces who do not belong to a technical society of any kind. The success of the Engineering Institute of Canada, as a national factor, must depend largely on the thoroughness and completeness of its representation.

The Gospel of Unity and Co-Operation Among Engineers

THE Prime Minister of British Columbia has written the Council of the Canadian Society of Civil Engineers to the effect that his government has refused to consider the application to incorporate the B. C. Engineering and Technical Institute, and that no further consideration will be given by the government. This letter was in response to a telegram from the Canadian Society, the action being taken because of protests against the use of the name and the powers requested.

In taking this course the B. C. Government would seem to have been well advised. The trouble in Canada has not been shortage of scientific organizations so much as lack of unity of purpose and enthusiasm in carrying on the work of the organizations already in existence. The biggest difficulty, of course, is our tremendous area which makes it very hard to keep the various provinces working synchronously. However, until such time as the existing societies have been utilized to the utmost and have proven their inability to cover the engineering field, there seems no good reason for a weakening of our energies by further subdivisions. The Western Coast field is pretty thoroughly covered by branches of various societies at present.

It is very possible there are local reasons (some of them personal, possibly) behind the request for another engineering society in British Columbia, but if it was intended to cover anywhere near the same field as the Canadian Society of Civil Engineers (and the name indicates that intent) we would urge engineers and technical men throughout that province to forget everything but the best interests of the profession and make up their minds right now to work along shoulder to shoulder with any whose ideals are in the direction of improving the status of the engineer. Neither the engineer, as an individual, nor any existing engineering society, as a body, is so firmly established in the public confidence as to be able to risk the criticism that is certain to follow any sign of disunity. At this very moment existing technical societies are preaching the gospel of unity and co-operation among engineers as never before. It is the first and absolute essential before it is possible that any progress can be made.

Committee on Prestige, Toronto Branch C.S.C.E., Submits Resolutions

At a meeting of the Toronto branch of the Canadian Society of Civil Engineers, held on Thursday evening, April 25, the following series of resolutions was adopted. The draft of these resolutions had been prepared by the Committee on Prestige of the Toronto branch, following a comprehensive report recently submitted to the branch and reviewed in our last issue:

Resolutions

1. That the Ottawa branch be invited to co-operate with the Toronto branch in the drafting of a bill for the restriction of the employment of engineers upon public works, such as federal, provincial, and municipal works, to those who have conformed to the requirements which shall be defined therein; and such draft, after being approved by the respective branches, to be submitted to the Council of the Institute for prompt consideration and action.

2. That legislation be obtained forbidding the expenditure of public funds upon the construction of bridges, roads, docks, harbors, waterworks, sewerage and sewerage works, electric light and power works, and other undertakings, unless the plans for the same shall have been prepared by and the supervision is under the control of engineers who have conformed to the requirements defined in the proposed draft bill mentioned in Resolution No. 1.

3. That it is desirable that the branch shall make provision for the payment of the branch secretary, and that it shall be deemed part of his duty to keep in close touch with the members and to render every assistance for their professional advancement.

4. That the Council of the Institute be asked, in order to secure material for further discussion, to issue an enquiry to the members generally to ascertain the compensation received by engineers of various ages and in different classes and employed in various technical services, and that steps be taken, if possible, to ascertain also the compensation paid to men of corresponding ages, classes, and services in other professions.

5. That the Council be asked to organize a scheme for the defence of members who have been attacked in the performance of their professional duties on what may appear unjustifiable grounds.

6. That the technical work of the Institute can be most successfully carried on by means of technical sections, to which shall be entrusted the organization of ordinary meetings, special sectional conventions, etc.

7. That the Executive Committee be requested to consider the suggestion of holding weekly or fortnightly lunch meetings, at which addresses will be delivered and facilities given for the members to become better known to each other. Such practices as obtain at meetings of the Rotary or the Electrical Clubs might be followed.

8. Whereas in the vocation of engineers technical knowledge is necessarily of primary importance, that the Council be asked to adopt every means in their power to make transactions of the Institute a complete record of Canadian engineering achievements and of Canadian engineering studies.

9. That it is desirable to appoint sectional technical committees, who shall undertake special studies and investigations to be assigned to them. The appointments to such committees to be made only after formal acceptance of office by the nominees, and the work of the technical committees to be carefully supervised by the Executive Committee. In the case of appointees failing to carry out the work the executive shall, after due notice, request their retirement and elect others in their places.

10. That the Committee on Prestige and Influence be continued.

Toronto Section of the A.I.E.E.—Annual Meeting

It is a matter of regret that there were no representatives of the manufacturers to discuss the paper by Mr. Ackerman, of the Toronto Power Company, on High Tension Insulators, which was read by the author on Friday April 19. The paper, which dealt with the operating aspect, was a most thorough one and showed not only the improvements which the last decade has brought about in the line insulator, but also the opportunity for further development in producing an insulator which should prove more resistant to power arc discharges and punctures. The modern pin type insulator shows a somewhat more compact design than that of ten years ago, being more free from deep and intricate cavities which were of little use in preventing leakage and none at all in reducing the risk of flash-over. Mr. Ackerman commented upon the desirability of drawing the arc away from the insulator and pointed out that arcing horns and the well-known Nicholson Ring were not thoroughly effective in this respect as they rather tended to localize the flash-over until it was ruptured or until the insulator failed. A new type of arcing horn was described which took the form of a spiral around the wire with a radius equal to the depth from the wire to the foot of the insulator pin. It was shown by a remarkable series of photographs that this would instantly draw the arc well away from the insulator towards the tip of the horn, and that until the short was cleared no damage could happen to the insulator.

In the discussion Mr. H. C. DonCarlos did not agree with the author in extending the field of pin type insulators into the region above 60,000 volts; rather would he expect to see suspension insulators adopted for 44,000 and all higher tensions. In conversation with the engineers of the Mississippi River Power Company he had learned that practically all the failures on their 110,000 volt lines had been due to cracks in the porcelain, and he believed that this experience was not unusual. Mr. Davison pointed out that among other advantages the suspension insulator permitted of easier testing of the insulators on location and furthermore, that it lent itself to standardization. If manufacturers were to be asked for pin type insulators of 50,000, 60,000, 70,000 volts and higher pressures, the cost of insulators would naturally be higher and the deliveries less satisfactory than were suspension strings of standard elements were specified for these voltages. A number of other most interesting points were raised in the discussion which tended to demonstrate that there is considerable diversity of personal opinion among transmission engineers regarding the insulator problem, and that the same problem is being effectively solved in more than one way in different installations.

The result of the elections for officers of the Toronto Section was declared at the meeting of Friday, April 19, as follows:—

Chairman—Arthur J. Hull (Hydro-electric Power Commission).

Secretary—Ernest V. Pannell (British Aluminium Company, Limited).

Executive—Ashton B. Cooper (Canadian General Electric Co., Ltd.); Frank R. Ewart (Ewart & Jacob); William G. Gordon (Malm, Gordon & Co.); W. Percy Dobson (Hydro-electric Power Commission); William Volkman (Toronto Power Co.); *Herbert B. Dwight (Canadian Westinghouse Co., Ltd); *Gordon R. Langley (Canadian General Electric Co., Ltd.).

(*Out of town members).

Warfare Against Needless Loss of Life and Property by Fire

ALCIDE Chausse, city architect and superintendent of buildings of the city of Montreal, and chairman of the Committee on Fire Prevention of the American Society of Municipal Improvements, recently made his annual report to that society, noting the activities relative to fire protection during the past year.

The report noted the recommendations made at its last annual meeting of the National Fire Protection Association regarding the warfare against the needless sacrifice of human life and property by fire which were as follows:

1. The adoption by municipalities of the Standard Building Code of the National Board of Fire Underwriters to the end that fire-resistive building construction may be encouraged, the use of inflammable roof coverings prohibited, adequate exit facilities from buildings assured, and interiors so designed and fire-stopped as to make easy the extinguishment of fires therein.
2. The adoption by all states of minimum building requirements for the protection of State and County hospitals, asylums and similar institutions outside city limits and of small communities in which the establishment and enforcement of a building code is impracticable.
3. The enactment by each state of the fire marshal law advocated by the Fire Marshals' Association of North America to the end that official investigation may be made of the causes of all fires. Preventable fires may be eliminated by public education, and the crime of arson stamped out.
4. The adoption of the Association's suggested ordinance providing for the systematic inspection of all buildings by city fire marshals or local firemen, to insure the vigorous enforcement of rules for cleanliness, good housekeeping, and the maintenance of safe and unobstructed exits, fire-fighting apparatus and other protective devices.
5. The enactment of ordinances similar to that of Cleveland, Ohio, fixing the cost of extinguishing preventable fires upon citizens disregarding fire prevention orders, and a more general legal recognition of the common law principle of personal liability for damage resulting from fires due to carelessness or neglect.
6. The wider general use of the automatic sprinkler as a fire extinguishing agent and life saver and the more general adoption of the fire division wall as an important life saving exit facility.
7. A careful study of the technical surveys of cities made by the engineers of the Committee on Fire Prevention of the National Board of Fire Underwriters covering the items of water supplies, their adequacy and reliability, fire department efficiency, fire alarm systems and conflagration hazards; and of the possibility of co-operation among neighboring cities through mutual aid and the standardization of hose couplings.
8. The adoption of the Association's suggested laws and ordinances for state and municipal regulation of the transportation, storage and use of inflammable liquids and explosives.
9. The universal adoption and use of the safety match and legislation prohibiting smoking in all parts of factories, industrial and mercantile buildings except in such fireproof rooms as may be especially approved for the purpose by fire departments.
10. The education of children and the public generally in careful habits regarding the use of fire.
11. The co-ordination of all these activities, through a central administrative officer or body of the state or city having primary jurisdiction, for the purpose of promoting uniformity of action and efficient co-operation.

In the furtherance of these objects the Association appealed for the co-operation of all citizens. It asked them to help in the dissemination of its valuable literature and in the use of the standards of fire protection so carefully worked out by its committee to the end that the lives and substance of our people shall not continue to be dissipated by a reckless and easily preventable waste.

The report then reviews the recommendations that have been adopted by various municipalities on the continent looking to reduction of fire waste—Kansas, Ohio, Louisiana, Chicago, Minnesota, Texas, etc. The report ends with a discussion of the treatment of chimneys and the penalty that should attach to neglect in keeping them clean; the by-law in force in Montreal is quoted as a model which would probably also be effective in other cities.

Halifax Branch C.S.C.E.

Pursuant to authority granted by the Council of the Canadian Society of Civil Engineers, a Halifax branch of this organization was formed on Friday evening, April 19, at a meeting held in the Technical College. Until such time as the amalgamation of the Nova Scotia Society and the Canadian Society now under way is consummated whereby the local membership of the Canadian Society will be considerably increased, a temporary organization only was effected, The officers appointed are: F. A. Bowman, chairman; K. H. Smith, secretary-treasurer, together with a managing committee comprising L. H. Wheaton, W. P. Morrison, P. A. Freeman, J. Lorn Allan, R. McColl and Hiram Donkin, district councillor of the Canadian Society as member ex-officio.

Creosoted Blocks for Factories

ALTHOUGH wood block has been used extensively for pavements, it is only recently that it has come to be recognized as a satisfactory material for mill and factory floors. Munition factories in the past three years have used wood block extensively, its noiseless nature, cleanliness, and ease of tread being factors which are bringing it rapidly to the front as a floor material. Perhaps the reason wood block has not been more generally used in the past is due to the fact that failures sometimes occur. By careful consideration in the method of construction and materials used these can be largely eliminated, however.

Manufacture of the Blocks

Great care is necessary in the manufacture of the blocks, which may be varied to suit the conditions to which the block will be subjected. Dry conditions require air-seasoned lumber, for it has been found that untreated lumber will contract more than 6 per cent. in volume in drying from the green to the dry state, or a block measuring 4 inches wide by 8 inches long would contract ¼ inch in width and ½ inch in length.

Blocks which are to be used on floors where moist and humid conditions predominate should preferably be manufactured from only partially-seasoned lumber, or, if dry lumber is used, it should be subjected to live steam to swell the blocks during the treatment. The length of the blocks should not exceed three times the depth. This is especially true of shallow-depth blocks—i.e., those 2 in. and 2½ in. deep. There is a decided tendency for these blocks to curl and warp when of excessive length. In treating the blocks with creosote oil by the compressed air, vacuum method, it is inadvisable to specify treatment of less than 8 pounds of creosote oil per cubic foot of timber; otherwise the blocks will not be impregnated to the point of refusal.

Methods of Construction

The matter of foundation for the floor is of great importance; concrete should always be used. If timber is used it should be treated to prevent decay. The concrete should be of the required depth to withstand the load to be imposed. If a cushion is used, it should be composed of dry mortar and average not more than ½ in. in depth. The concrete in this case should be finished level so that the depth of cushion will not vary more than ¾ in. A good mix consists of one of cement to four of sand, spread fairly dry.

Where there is no vibration, and where the floor is level, a thin sand cushion, evenly applied and not over one inch in depth, will give good satisfaction. Laying too thick a layer of sand, and using the sand to fill up irregularities in the concrete base, is a frequent source of failure by shifting of the blocks. Where moisture under the floor is to be expected or where the traffic is unusually heavy, it is good practice to finish the concrete to a smooth and level surface, exactly the depth of the block below the finished floor level, not allowing for a cushion.

Blocks laid directly on the concrete cannot be tamped, and require an even bearing to prevent them from splitting under traffic. Shallow blocks, 2 to 2½ inches deep, may be used to advantage when there is no cushion, and in most cases will give good service.

The bituminous filler should be of a special grade; coal tar pitch is better than asphalt, as it is more easily obtained and is better adapted to the purpose. The filler should penetrate to the full depth of the blocks; it should be heated to the point where it is thoroughly liquid, and should be flushed into the joints from the top, using a rubber-edged squeegee. The surface should then be covered with sand and permitted to remain for three or four weeks, if possible.

Canadian Good Roads Congress

THE secretary of the Canadian Good Roads Association, Mr. G. A. McNamee, 909 New Birks Building, Montreal, has issued a very interesting programme of the Fifth Canadian Good Roads Congress which will be held at the Royal Connaught Hotel, Hamilton, May 7 to 10. On the front page is shown a fine type of country roadway, which is designated "A war winner," as indicating the value of good roads in war time. Another illustration showing the type of road all too common in Canada during the early months of the summer, provokes the apt enquiry, "Why not have our road controller order mudless roads?" A goodly part of the folder is taken up with definitions of road terms, which the average road man will find of considerable value.

The executive officers of the Canadian Good Roads Association are as follows: President, Capt. J. A. Duchastel de Montrogue, city engineer of Outremont, P.Q.; vice-president, S. L. Squire, municipal adviser to the Ontario Government; secretary-treasurer, Geo. A. McNamee, Montreal. Messrs. U. H. Dandurand, of Montreal, W. A. McLean, Deputy Minister of Highways for Ontario, B. Michaud, Deputy Minister of Roads, Province of Quebec, and Capt. O. Hezzelwood, of Toronto, are honorary presidents. The directors include the following gentlemen, in addition to the officers: Thos. Adams, Town Planning Adviser, Commission of Conservation; A. L. Caron, president Automobile Club of Canada, Montreal; Dr. E. M. Desaulniers, M.L.A., deputy speaker, Quebec Legislature; R. S. Henderson, president, Manitoba Good Roads Association; Geo. Hogarth, Chief Engineer, Ontario Highways Department; J. W. Levesque, M.L.A., Montreal; A. F. MacCallum, Commissioner of Works, Ottawa; P. E. Mercier, chief engineer, city of Montreal; J. A. Sanderson, Oxford Station, Ont.; C. R. Wheelock, President, Ontario Good Roads Association; W. G. Yorston, Asst. Road Commissioner, Province of Nova Scotia; W. Findlay, Ottawa.

The programme lists the following topics for discussion and suggests that if these do not supply all the information desired the "question box" will:

Topics for Discussion

The Road and the Farmer.
Who Should Pay for the Road?
The Efficiency of the Highway in the Present Transportation Difficulties
The Most Important Consideration Entering Into Road Construction—Drainage
Result of Tests with Various Types of Pavements
Modern Practice in Bituminous Pavements
English and American Practice in the Construction of Tar Roads
Concrete Roads
Abatement of the Dust Nuisance
How the Good Roads of France are Helping Win the War
Roads for the Common People—Gravel and Macadam
The Labor Shortage Solved by Efficient Machinery

Experiments on Diffusion of Sewage

By Kenneth Allen*

From experiments made by the Metropolitan Sewage Commission of New York in the laboratory and in the open harbour, several interesting conclusions were drawn. In still water sewage will first rise toward the surface or fall toward the bottom, depending upon the relative specific gravity of the two liquids. In sea water, it will rise, while in fresh water it will remain for a longer period about the level of discharge. Diffusion begins at once and is more rapid the less the salinity of the water. It probably bears some relation to the form of the jet, but at this stage it is of less importance than the mixing action due to currents. Where turbulent eddies occur mixing is rapid and the buoyant tendency due to the difference in specific gravity is obliterated. After this initial mixing further tendency toward putrefaction is usually deferred for at least several hours.

It was observed that when discharged into an equal mixture of sea and fresh water sewage rises from depths not exceeding 30 ft., so that it will probably be visible at the surface; but from depths of over 40 ft. it will probably not be seen unless discharged in very large volumes, although much depends upon the existence of subsurface currents.

Diffusion in Saline Waters

A high salinity of the water retards diffusion. Streams of sewage are diffused more slowly in tidal waters than in rivers of fresh water. Moreover, salinity increases the upward tendency in submerged effluents, so that they reach the surface more promptly and hence with less opportunity for diffusion. For these reasons and because the saponification of the soaps in sewage renders it more nearly opaque, because its capacity for dissolved oxygen is less and because any decomposition of sludge deposits gives rise to more offensive odours in salt water than in fresh, the latter is generally a more favorable medium into which to discharge sewage.

The effluent from a submerged outlet in salt or brackish water rises to the surface in the form of a cone, spreads rapidly in a thin sheet so that at a moderate distance there is usually little evidence of pollution below a foot or two from the surface, although the line of demarcation of the sewage field may be quite definite for a considerable distance.

With a septic sewage, high temperature, and a stream low in dissolved oxygen, conditions favor putrefaction, and particular pains should be taken to secure rapid diffusion. The desirability of this is becoming recognized in the construction of submerged sewer outlets.

At Moon Island 50,000,000 gallons of crude sewage from Boston is discharged near the surface on the first two hours of ebb tide. The sewage is dark, septic, foul in appearance, and with a strongly offensive odour, although gross pollution is confined to the upper 5 feet in depth of water. Discoloration of the water at times covers 1,000 acres, half of which may be called "offensive," and extends for a distance of over 1½ miles from the outlet.

A marked improvement is observed in the continuous discharge of 60,000,000 gallons per day off Deer Island from the North Metropolitan system. The discoloration is hardly noticeable below 2 feet from the surface, and little evidence of sewage is ordinarily found beyond a distance of 900 feet.

This marked improvement over the Moon Island outlet is attributable to the fresher condition of the sewage and its continuous discharge at correspondingly lower rates. But even here the sewage field may be detected as much as 1½ miles from the outlet under certain conditions.

The more recent two outlets from the South Metropolitan system near Peddocks Island, Boston, marked a further improvement in being placed a depth of some 30 feet of water at low tide. Here 53,000,000 gallons per day are discharged continuously, but there is no marked discoloration more than 30 feet from the outlet.

The discharge of 67,000,000 gallons of the sewage of Washington from two outlets at a depth of about 28 feet in the Potomac River is difficult to detect at the surface, and the same may be said of that from the three outlets at Hamburg, where 53,000,000 gallons per day enter the Elbe. In these examples there are the additional advantages of a discharge into fresh water, and in dividing up the flow between two or more outlets.

The Deer Island outlet in Boston Harbour is being extended 300 feet into water 52 feet deep at low tide. For about 240 feet this is of 7-foot cast-iron pipe converging to 4 feet at the extreme end. The last 126 feet is composed of lengths having openings near the middle and in the top directed forward, by which the discharge will take place at fourteen orifices, including the end of the last pipe.

It has been proposed to construct outlets for the Passaic Valley sewer in New York Upper Bay, conical in shape, diverting upward and with a spiral flange on the inside for the purpose of delivering the sewage in the form of a thin, hollow cone. This, it was expected, would provide a large surface of contact with the bay water immediately after discharge.

Multiple Outlets

Another feature of the Passaic Valley outlet is in providing multiple outlets. This has frequently been proposed in order to secure rapid diffusion, but has seldom been carried out. At Toronto the outfall was carried out about 3,200 feet from shore to a depth of 21 feet. The last 500 feet was tapered from a diameter of 5 feet to one of 2 feet and perforated with 4-inch orifices 4 ft. 4 in. apart.

Another example of multiple outlets is in the new outfall at Cleveland, where 70,000,000 gallons are discharged daily one-half mile from shore at a depth of 30 feet from 6¾-inch holes, spaced 7½ feet apart on each side of the tapered outlet pipe and 45 degs. above the horizontal diameter.

There is an advantage in a high velocity of discharge, but as this involves loss of head it cannot often be made use of unless the sewage is pumped. A horizontal is preferable to a vertical direction for the jet, as it offers a greater opportunity for diffusion during the ascent to the surface, after which this proceeds more slowly.

At Copenhagen, to secure a similar result, there are provided two openings 6 inches wide by 4 feet long near the outer end of the new 43-inch wood stave outlet pipe, by which the upward discharge of 33,000,000 gallons per day will take place in the form of a thin sheet.

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*Engineer of Sewage Disposal, New York City, in The Surveyor.

The area of pollution increases at a higher rate than the volume of discharge, so that the interception of large volumes of sewage to a single outlet is unwise if the conditions are unfavorable for sufficient diffusion and dilution.

Principles to be Followed

With so many factors involved it is impossible to formulate precise rules for the location and design of sewage outlets to secure prompt diffusion, but the principles to be followed are well known and may be summarized as follows:—

1. Locate the outlet in water: (a) as nearly fresh as possible, (b) as nearly saturated with oxygen as possible, (c) with the swiftest possible current, (d) at as great a depth as possible.
2. Discharge the sewage so as to secure as intimate a contact with the water on discharge as possible. This may be prompted by special orifices and by multiple outlets.

Steel Bridge over Richelieu River

Rebuilt on Site of Old Wooden Structure with Little Interruption to Traffic

HEREWITH we illustrate a new steel bridge built over the Richelieu River at Chambly Canton, P.Q., for the joint use of the Montreal and Southern Counties Railway Company and the Central Vermont Railway Company. It replaces an old wooden bridge, the work being carried out with little interruption to traffic.

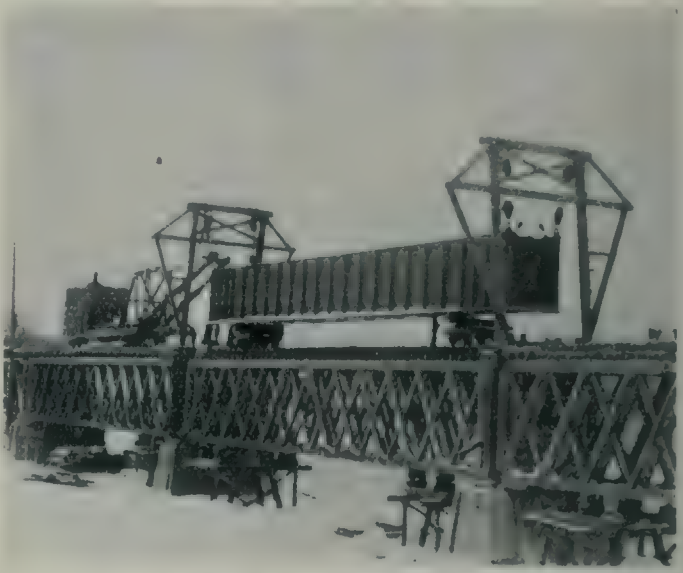
The bridge is 724 feet 9 inches long, and consists of seven spans supported on two shore abutments and five concrete piers. Each span is approximately 97 feet in length.

The original wooden structure was a Howe truss 16 feet. The new structure is of the deck plate girder type, the depth of the girders being 10 feet. The steel bridge has more than double the carrying capacity of the old structure. Before the steel spans could be set it was necessary to re-construct the concrete piers, adding a reinforced concrete cap to each pier, as well as to the land abutments, to take care of reductions in girder.

The difference in the distance between the parallel trusses of the old wooden structure and those of the new steel bridge were such as to allow the steel members to be placed inside the wooden trusses without disturbing their original location. This fact made it possible to renew this bridge without any appreciable delay to traffic. The work of wrecking the old wooden structure was carried on after the new bridge was in place.

The overhead wires of the Montreal and Southern Counties Railway were originally supported on wooden poles bolted to the wooden truss. When this was removed, however, it was necessary for the company to provide suitable means of support for their overhead system. This was taken care of by erecting four steel towers at approximately 150 feet center to center, from which is suspended the trolley, as well as feeder and telephone wires. These towers are riveted to the webb members of the steel girders.

The re-design of the piers and bridge structure was carried out jointly by Mr. H. P. Stewart, structural engineer, Grand Trunk Railway System, and Mr. J. M. Morrison, engineer and superintendent of structures, Central Vermont Railway. Supervision of the work in the field was under the direct charge of Mr. J. M. Morrison.


Lowering sixth span Richelieu River bridge, Feb. 28, 1918.

All reinforced concrete work was carried out by the Bridge & Building Department of the Central Vermont Railway, and the steel work was erected by the Dominion Bridge Company, of Montreal.

To Save Grain from Fire

A builder of grain elevators suggests that in order to save wheat and other grain in food elevators in the event of fire, every bin should be provided with a trap door in the outer wall of the building, so arranged that in case of fire the door could be pulled open and the grain there thrown out on the ground. By quick cheap alterations to many existing elevators he believes it would be possible to save much grain now lost in fires.

With a view to securing greater efficiency the Montreal civic commissioners are grouping the various departments into five divisions. The public works will include the streets, sewers, municipal buildings, incineration, inspection of buildings, and electrical commission. Several new departments, comprised in the above, are now under the charge of the chief engineer. A manager of each group, responsible to the commissioners, will be appointed.

The fourth annual convention of the American Association of Engineers, meeting jointly with the Committee on Engineering Co-operation, will be held in Chicago, at the City Club, 315 Plymouth Court, on Tuesday, May 14. Delegates from all national, state and local engineering societies in the United States, will be entertained. The greater part of the time and energies of the convention will be given over to a discussion of "what more can engineers do to win the war?"

Bonus for Men Increases Yardage

COSTS per square yard of paving were reduced from 21 cents to 12 cents, yardage was increased from 3,390 to 5,485 square yards in a two-weeks' period, and labor turnover was reduced by the city of Flint, Mich., which is constructing by day labor approximately ten miles of pavements and thirty miles of sewers this season. This is the experience related by C. E. Ridley, Engineer in charge of Pavement Construction, Flint, Mich, in Engineering Record. The city had experienced a great deal of labor difficulty. The chief industry of Flint is the manufacturing of automobiles, which has made heavy inroads on the supply of skilled labor. Extensive building contracts under way have further increased the labor shortage.

The particular crew in question had been a problem all season. Foremen had been changed four times, and the entire personnel of the crew at least as many times. Changing foremen and laborers and giving a bonus only to foremen were all to no avail, the cost remaining above the estimate and the quantity of work done fast falling below the schedule.

This contingency led to figuring out a bonus system, whereby every man on the job would share according to the amount of work done. The proposition was made to the men that each man on the job should receive a bonus of one cent per square yard in excess of his regular wages for all over 500 square yards of 6-inch foundation placed in a 10-hour day. The gang was limited to twelve men, exclusive of the foreman. Previous to this as many as sixteen men were allowed. The gang was composed of a foreman at $4.17 per day, an engineer at $4, a fireman at $3.33, a cement carrier at $3.75, three concrete men at $3.50 and six shovelers and wheelers at $3.50 each.

At the above wages and allowing to each man the one cent bonus per square yard for all over 500 yards, the unit costs would vary as follows: 300 yards, 15.6; 400 yards, 11.7; 500 yards, 9.4; 600 yards, 10.0; 700 yards, 10.4; 800 yards, 10.7; 900 yards, 11.0; 1,000 yards, 11.2.

As seen in the foregoing, approximately 500 square yards per day would give the minimum cost, but where the overhead expense is considered, to say nothing of the desirability of getting through a job with as little inconvenience as possible to traffic is taken into account, almost everybody would be unanimous for the 1,000 square yards per day, with only a difference of 1.8 cent per square yard.

Now as to the practical side of the method. The payroll of this particular gang referred to, previous to the time of trying the bonus method, amounted to $708.68 for a two-weeks' period, during which time they placed 3,390 square yards of 6-inch concrete foundation on pavements varying from 21 to 24 feet in width. The average for the twelve days was 283 square yards per day at a cost of nearly 21 cents per square yard.

The next payroll of the gang on the same kind of work, including the bonus, amounted to $646.45. In the same period of time they deposited 5,485 square yards at an average cost of less than 12 cents per square yard. During the first period the weather was such that no delay was necessary, while during the second period rain interfered with the work on six different days and on two days they were unable to operate at all. In spite of this handicap the gang averaged 548½ square yards a day. One day, with weather permitting them to run only 9 hours, they placed 882 square yards. The result was an increase of 62 per cent. in yardage and a decrease in cost of 43 per cent., compared with the previous two-weeks' period.

Roadman Thomas Atkins—An Appreciation

By Major T. Salkield, R.E.

The important work of the men composing the Road Battalions at the Front has perhaps hardly received at home the recognition it deserves, but the following verses, by Major Salkield, the city engineer of Delhi, who has long been in daily contact with them, shows that among their officers at any rate there is no lack of appreciation of their labors:—

He looks a Tommy Atkins when he's in his khaki kit.
Course he is a Tommy Atkins, and he's proud to do his bit;
He's not so young as Tommy, and his tunic's sometimes slack,
He's not so straight as Tommy with a kit upon his back.
He's hasn't done much drilling to be level with his peers;
He never thought of soldiering—these men are volunteers.
All honour to these heroes—when the cry went up, "Bad roads,"
When truth came out that routes in France were not designed for loads,
When the Armies could not operate because the transport stood,
And could not stem the muddy roads with hungry Tommy's food,
When traffic was congested and a menace to the nation,
These men came in, played well their part, and saved the situation.

The Roadman Tommy Atkins, you can spot him at a glance,
Anywhere on any road in dangerous parts of France;
He doesn't hop the parapet and charge o'er "No Man's Land,"
He doesn't march along the streets preceded by a band.
He isn't often exercised at gym to make him fit,
He isn't in the trenches with the lads that do their bit;
He isn't trained to shoot and ride and use a bayonet slick,
But he's used his spade in self-defence, and tackled Boche with pick—
This happened when the Hun came through and rounded up a section
Of roadmen working near the line—the place I dare not mention.
He isn't smart when on parade beneath his O.C.'s scan,
But he's played a very gallant part like any fighting man.

To keep the lads who hold the line supplied with all they need
Is a tallish proposition, well known to those who read;
For the roads have got to be maintained from bases—port and land—
From larger base to smaller base to dumps on every hand;
On line communication, areas back and forward, too,
Roads and railways—rails and roadways—pushing up and getting through.
Hard work—yes—without cessation when they're in the danger zone.
No "ca' canny," no eight-hour shifts making roads and hauling stone;
No trim cottage with a garden and a comfy bed for sleep,
No good missus to be useful when her man feels very cheap.
Only dug-outs, tents and billets, huts of various shape and size,
Where to spend a few hours daily until darkness closes eyes.
Sleep—not always—often none, for the shells fall very near,
And the kultured Hun comes bombing—puts the wind up—never fear.

Yes—these men have served their country right loyally and well,
Better far than all the tributes to their skill and bravery tell,
And I only sing their praises till a singer with more skill
Sings a song in better language—never with a better will.

France, February, 1918. —The Surveyor.

Angles to the Right—Time and Labor-Saving Scheme in Survey Work

In a recent issue the Engineering News-Record prints a letter from H. H. Armsby, Instructor of Civil Engineering, University of Missouri, describing the method of surveying known as "angles to the right."

The method consists in taking all horizontal angles " to the right," or in a clockwise direction, no matter whether this makes them interior or exterior angles, and regardless of the resulting size of the angle, taking the backsight at each station with the plates set at zero. It is therefore somewhat similar to the ordinary azimuth method, with the difference that the zero point is the backsight at the station occupied instead of the south point.

The advantages which the advocates of the method claim for it are:

1. There is less chance for error in recording the angles than when deflection angles are used, for in this methor there are no "left" angles. Also the error introduced in plunging the telescope is eliminated.

2. A sketch is not necessary to show which way the angle was read, as is the case with interior or exterior angles.

3. There is less chance for error if all angles are read in one direction than if some are read one way and others in the opposite direction, as the engineer very quickly becomes accustomed to reading all angles one way and does so instinctively.

4. Unlike the azimuth method, the angles can be doubled, or in fact repeated as often as desired, which is the best way with which the writer is familiar of checking work in the field.

5. The angles may be very easily transformed into deflection angles if desired for plotting, by one simple mental subtraction, as follows:

> If the angle to the right is **more** than 180 degs., subtract 180 degs. from the angle, and the result will be the deflection angle to the **right.**
>
> If the angle to the right is **less** than 180 degs., subtract the angle from 180 degs., and the result will be the deflection angle to the **left.**

6. For computing azimuths and calculated bearings, either for plotting or computation, notes of angles to the right may be reduced much more easily than any other form of notes, as they can be computed by a process involving only simple addition and subtraction, and a simple rule may be written which will cover all cases. The rule is:

> To the last azimuth (that of the line coming **up to** the station occupied) add the angle to the right, subtract 180 degs., and the result is the new azimuth. If it is impossible to subtract 180 degs., as above, **add it.**

This rule covers all cases, and is very simple and easy to remember, requiring no elaborate sketches to determine the new bearing, for, of course, the relation between the azimuth and the bearing of a line is too simple to need comment. It therefore does away with what is considered by most engineers a bugbear if nothing worse—the computation of calculated bearings.

The second sentence of the rule is, of course, equivalent to first adding 360 degs and then subtracting the 180 degs., as before, and, of course, the addition of 360 degs. to an azimuth does not change it. Similarly, another sentence might be added to the rule, as follows:

> If, **after** subtracting the 180 degs., as above, the remainder is larger than 360 degs., subtract 360 degs.

This rule should, however, be self-evident, as, of course, an azimuth of 390 degs. is the same as one of 30 degs.

New Arbitrators in Montreal Street Dispute

Mr. Justice Bruneau has declined to allow the city of Montreal to withdraw from arbitration the question of damages alleged to have been sustained by proprietors in Hochelaga Ward, Montreal, through the alteration of street levels. The city objected to certain arbitrators nominated by the Court, on the ground that they were either not competent or were likely to be prejudiced. The city wanted an architect, contractor and engineer appointed. As a result of legal proceedings the city and the proprietors arranged to quash the act of compromise agreed upon. Judge Bruneau, however, declined to allow this. One of the arbitrators has withdrawn, and the Judge decided that the objection to another was valid. He dismissed the city's objection to the third arbitrator as unwarranted, and qualified as presumptuous the city's claim to restrict the court to a choice of arbitrators from the ranks of architects, civil engineers, and contractors. The gentleman objected to—the Clerk of the Court of Appeal—was qualified to act in the matter, which was simply a question of fixing the amount of damages, and to do this the arbitrators need not necessarily be men of technical training in the professions named. To fill the two vacancies, the Judge nominated Mr. Adolphe Brassard, architect, and Mr. E. Gohier, real estate agent.

Canadian Bridge Company Appointments

The Canadian Bridge Company, Limited, Walkerville, Ont., announces the appointment of Mr. John W. Seens as sales manager with offices in the New Birks Building, Montreal, effective May 1, 1918. Mr. Seens was for the past seven years manager of the Structural Steel Company, Limited, of Montreal, until that company discontinued operations the latter part of last year on account of being obliged to surrender their leased shop. During the period under Mr. Seens' regime the Structural Steel Company successfully carried out the fabrication and erection of many of Montreal's largest buildings. They also furnished a large percentage of the steel work in connection with the large paper mill development in Quebec and Eastern Ontario in recent years. Mr. Joseph Labelle, formerly designing engineer of the Structural Steel Company, Limited, has been retained as sales manager in the Montreal office of the Canadian Bridge Company, Limited.

A number of temporary officers of the Halifax Branch of the Canadian Society of Civil Engineers have been elected. This action was taken to give those who are members of the Nova Scotia Society of Civil Engineers and are not members of the Canadian Society of Civil Engineers an opportunity to be elected as members of the Canadian Society, and thus become eligible for taking office in the new branch of the Canadian Society.

Champlain Drydock in Quebec Harbor

The Largest in the World—Entrance Width 120 ft. —Two Compartments 500 ft. and 650 ft. in length

By U. Valiquet, M. Can. Soc. C. E.*

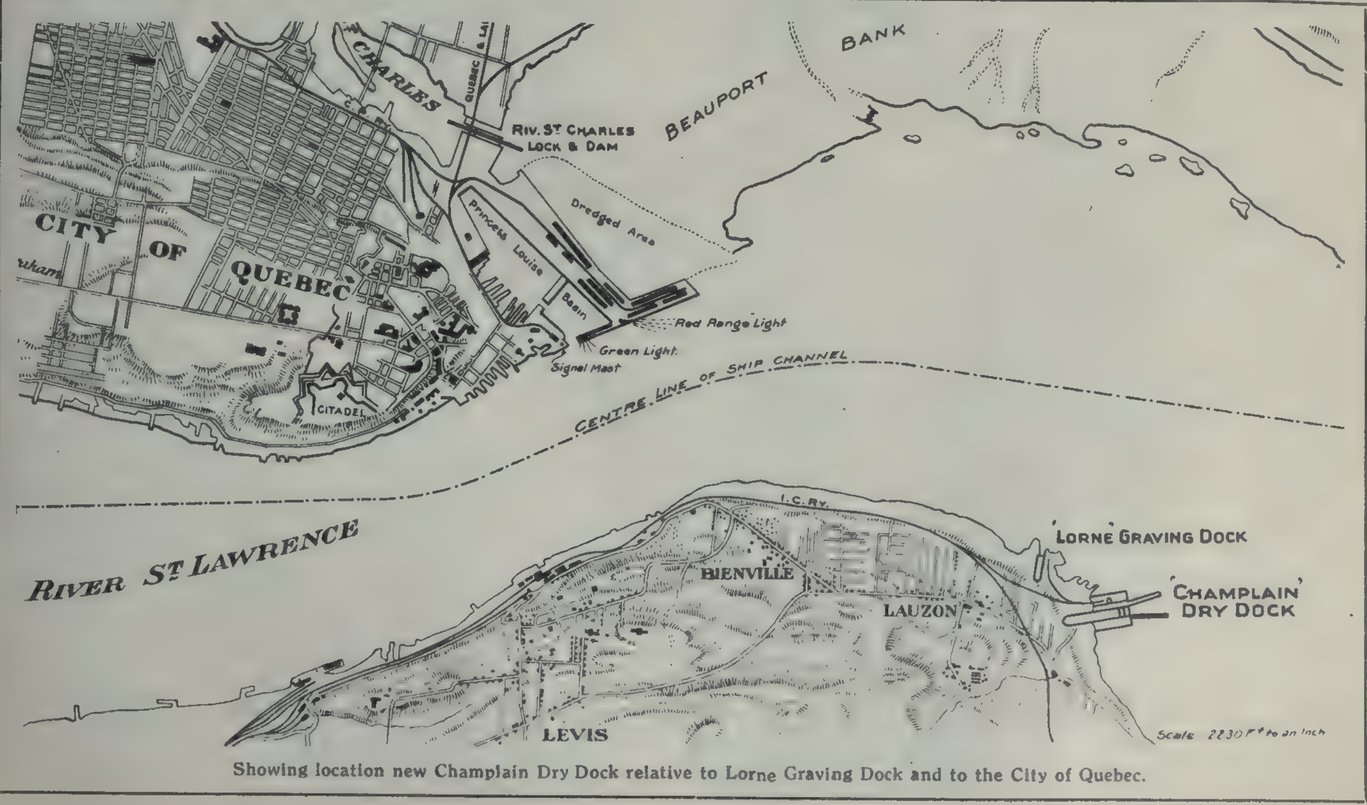
FOR a number of years the River St. Lawrence has been frequented by ocean steamers of such dimensions that they could not be accommodated in the Lorne Drydock, completed in 1886, at Lauzon, in the harbor of Quebec.

In 1906 the Canadian Pacific Railway Steamship Company brought out their steamers "Empress of Britain" and "Empress of Ireland," of 65-foot beam; the Allan Line steamers "Virginian" and "Victorian," of 60-foot beam, were also placed on the St. Lawrence route in that year. The "Bavarian," of somewhat narrower beam, 59 feet 3 inches, came to Quebec in 1905. Thereafter the number of large ships placed on the St. Lawrence traffic increased rapidly, until, in 1912, there were 25 vessels that could not have been repaired in the long stretch of the St. Lawrence navigation for want of sufficient dock accommodation, the width of entrance of the present drydock being only 62 feet. Any of these vessels that required docking had to be repaired temporarily as well as possible, while afloat, and taken either to Halifax or New York, which, in some cases, was a risky undertaking.

The case of the S.S. "Bavarian" was an unfortunate experience in this respect. On November 5, 1905, this steamer ran aground, with a full cargo from Montreal to Quebec, about 40 miles below Quebec, opposite Grosse Isle. Although late in the fall, she could have been raised and brought to Quebec had there been dock accommodation for her. Her beam was 59 ft 3 in., but through the accident her sides had bulged out beyond the width of the drydock entrance. She was raised in the following spring, although further damaged by ice during the winter, and brought on the beach a short distance below the drydock, where she was sold as scrap. This is the worst case on record in the history of the St. Lawrence navigation. This vessel was only six years old, and of a registered tonnage of 10,387 tons.

In the summer of 1898 the writer was instructed to prepare a report on the practicability of widening the entrance of the Lorne Drydock, which had been completed in 1886. A plan was submitted showing the possibility of obtaining an entrance 70 ft. wide, by removing part of the timber slides at the outer end of the dock; increasing the length was also suggested. The first was reported to be inadvisable, as it would greatly disfigure the dock and do away with the convenience of the timber slides. The only feasible way would be to remove and rebuild in another position the eastern side wall, thus depriving the harbor of all dock accommodation for probably two seasons. A new caisson would necessarily have to be provided; the cost would have been considerable. Further, it was considered that a new drydock would be required in Quebec before many years.

The suggestion of lengthening the dock was adopted. The length was increased from 484 feet to 600 feet; this consisted merely in moving the circular head, stairways, and timber slides 116 ft. further, after excavating the rock to proper width and depth. The work



Showing location new Champlain Dry Dock relative to Lorne Graving Dock and to the City of Quebec.

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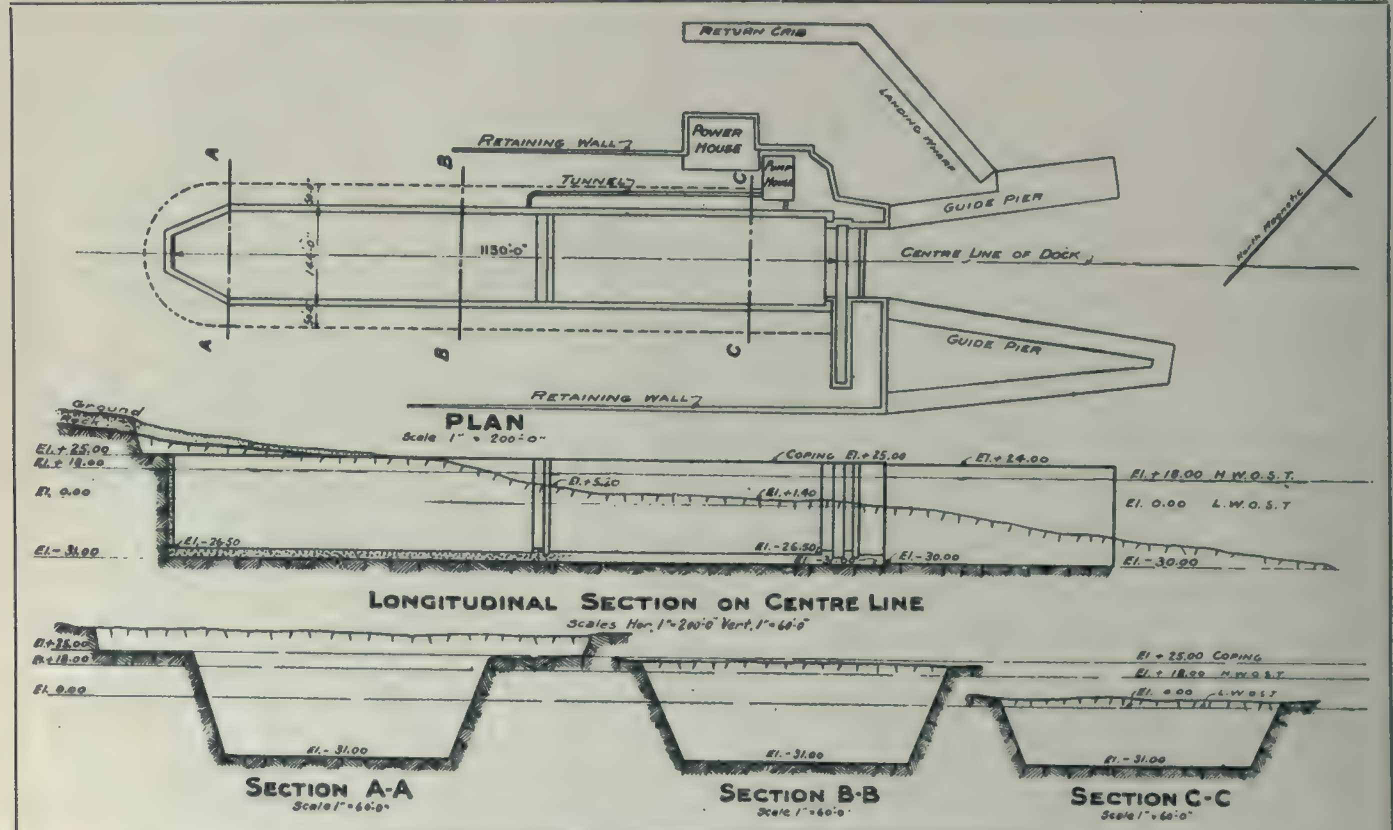
* Superintending Engineer, Department of Public Works. Read simultaneously before Montreal and Ottawa Branches C.S.C.E., April 25th, 1918.

was performed under contract awarded in the year 1900, for the sum of $100,000, and completed in 1901; without interfering with the use of the dock. The details of construction of this drydock have already been described in a paper read before the Canadian Society of Civil Engineers, some years ago, by Mr. St. George Boswell, chief engineer of the Quebec Harbor Commission, who was assistant engineer during the construction. This drydock was built by the Quebec Harbor Commission, under an Act, 38 Vict. Cap. 56-1875, by which the issue of bonds was allowed to obtain the necessary amount. The work was started in 1878 and completed in 1886, at a total cost of $921,130.

In 1888 the Canadian Government relieved the Harbor Commission of all obligations to refund the principal sum or interest expended on the drydock, and in 1890 it was placed under the control of the Department of Public Works; the writer was then placed in charge.



Typical plan and sections of Champlain Dry Dock, showing excavations.

New Drydock

In 1906 the Quebec Board of Commissioners urged upon the government the necessity for a large drydock for the harbor of Quebec. In the fall of the same year the writer was instructed to make a survey of the locality surrounding the old drydock and report on the best location. Two sites were examined, but the position to the east of the present dock was considered the most advantageous, for three principal reasons: (1) A larger area of land could be acquired; (2) a better foundation could be obtained; and (3) the repairing plant of Messrs. G. T. Davie & Sons could have better access to both the new and old docks.

A plan and report were submitted in the early part of 1907; the dock then proposed was 1,000 feet long, with an entrance of 100 feet. The proposition was not immediately acted upon; the question as to whether the government should build the dock or induce some shipbuilding firm to build it, under a subsidy from the government, was unsettled. The result of the discussion was the passing of an Act of parliament at the session of the year 1910, assented to on May 4, called an Act to Encourage the Construction of Drydocks. Under this Act the drydocks were divided into three classes. The first class included drydocks estimated to cost not more than four million dollars, and capable of receiving and repairing the largest ships of the British navy and of the following dimensions:

(a) Clear length on bottom, 900 ft.; clear width of entrance, 100 ft., with depth on sill at high water ordinary spring tides of 35 ft.

(b) Floating drydocks of a lifting capacity of 25,000 tons.

The second class included drydocks estimated to cost two and one-half million dollars, of the following dimensions:

(a) Clear length on bottom, 650 ft.; clear width of entrance, 85 ft.; depth of water on sill at ordinary high water spring tides, 30 ft., if in tidal waters; or 25 ft. on sill, if constructed in non-tidal waters.

(b) Floating drydocks of a lifting capacity of 15,000 tons.

The third class consisted of drydocks estimated to cost not more than one and one-half million dollars, of the following dimensions:

(a) Clear length on bottom, 400 feet; clear width of entrance, 65 ft.; depth of water on sill at ordinary high water spring tides, 22 ft., if in tidal waters; and 18 ft., if in non-tidal water.

(b) Floating drydocks of a lifting capacity of 3,500 tons.

The estimated cost in all cases includes the totally equipped repairing plant capable of effecting all sorts of repairs, including machine shops and tools, foundry, administration buildings, etc., together with the dock itself, but does not include marine slips or other installation used in the construction of ships.

According to the Act, the subsidy on drydocks of the first class is 3½ per cent. per annum on the estimated cost for a period of 35 years from the time it has been reported that the drydock is entirely completed. The subsidy on the second class is 3½ per cent. per annum for 25 years from the time of completion. On the third class the subsidy is 3 per cent. for a period not exceeding 20 years from the time of completion.

In all cases the company making the application must furnish plans, with a detailed list of the plant and a complete estimate of the cost. These are revised and corrected, if found advisable; and, upon a report from the chief engineer of the Department of Public Works that the works intended to be built are in the public interest the application is granted, upon certain conditions of management and maintenance. The works are to be executed under the superintendence of an officer of the department.

The above Act was amended in April, 1912, by making the length of the first class drydocks 1,150 ft., the entrance 110 ft., and the estimated cost five and a half millions. Another amendment was made in May, 1914, by which the subsidy of 4 per cent. on the estimated cost is allowed for first class drydocks. The Act was further amended in 1917, by which the dimensions of the first class drydocks shall be: Length on bottom, 1,150 ft.; width of entrance, 125 ft.; depth on sill at high water spring tides, 38 ft. A subsidy of 4½ per cent. on the estimated cost of five and a half million dollars is allowed, payable half-yearly for a period of 35 years from the time of completion. By this amendment no bonds or debentures are to be isued until one million dollars shall have been expended on the construction of the drydock.

After the passing of the act of 1910 shipbuilding firms were invited to build a drydock at Lauzon, in the harbor of Quebec, under the subsidy Act of that year. Two companies submitted plans and offered to build under contract, without reference to the subsidy Act. In 1912 another company submitted plans for a drydock to be built on the Quebec side of the harbor, just below the mouth of the St. Charles River, according to the subsidy Act, as amended in 1912. Some objection having been made to this location, and with no prospect in view for any other applicant, the Department of Public Works decided that a drydock would be built by the government.

The New Dock

In the early part of 1913 the writer was instructed to prepare plans and specifications, on which tenders could be called as soon as possible, for the construction of the new drydock, the location being to the eastward of the Davie Shipbuilding Yard, so that both the old and new drydocks would be easily accessible from the shops. Tenders for the construction of this work were advertised on May 12, 1913, to be received on June 30 following. The contract was awarded to the lowest tenderers, Messrs. M. P. & J. T. Davis. The contract was signed on October 7, 1913.

The new dock was at first intended to be built on a line parallel to the old drydock, but this was objected to from the point of view of navigation. A commission was appointed in the fall of 1913 to investigate and find out which direction would best suit the entrance facilities, and it was decided that the centre line of the dock should form an angle of 69 degrees with the direction of the old drydock, or approximately 45 degrees N.E., and it was so laid out.

Owing to the limited time available before the calling of tenders, general plans only were prepared, together with an estimate of the cost. The requirements as to details for the machinery and caissons were stated in the specification; the contractors were requested to furnish during construction all detail plans, to be submitted for approval by the department.

The drydock has the following general dimensions. Total length from outer caisson to head wall 1,150 feet, divided into two compartments. Outer part, 500 ft.; inner part, 650 ft.

Width of entrance	120	feet
Width at coping	144	“
Width on floor	105	“
Depth on sill at high water, S. T.	40	“
Depth on sill at low water, S. T.	22	“
Spring tides rise	18	“
Coping of side wall above high water, S. T.	7	“
Floor at outer end below outer sill	4½	“
Slope of floor transversely	1 in 100	
Western guide pier	400	feet
Eastern guide pier	500	“
Depth in entrance channel at low tide	30	“

The land expropriated in connection with the construction of the drydock has a superficial area of 25½ acres, of which 11½ acres are reclaimed beach land.

The outer entrance of the dock is closed with a rolling caisson, the top of which is provided with an automatic folding bridge; a floating caisson closes the inner entrance. This caisson can also be placed to close the outer entrance in cases when repairs are required to be made to the rolling caisson.

Three main centrifugal pumps, each of 63,000 gallons per minute capacity, are used to empty the dock; two pumps of 6,000 gallons per minute each are used to keep the dock dry. All pumps are run by electric power. Eight boilers, of a total capacity of 3,600 horse-power, furnish the steam at 200 pounds pressure to run the three direct current turbo generators of 1,500, 750, and 300 kilowatts respectively, which furnish the current at 550 volts to run the pump and other motors.

A direct current generator of 100 kilowatts at 220 volts, driven by a steam engine, will furnish the current for the lamps around the dock and in the buildings. There are 24 lamps of 500 watts, hung from poles around the dock. The poles are made of gas pipe, with the lower end set into sockets fitted with electric connections, and made removable in case of necessity. All electric wiring for lamps and motors outside of the buildings is placed underground.

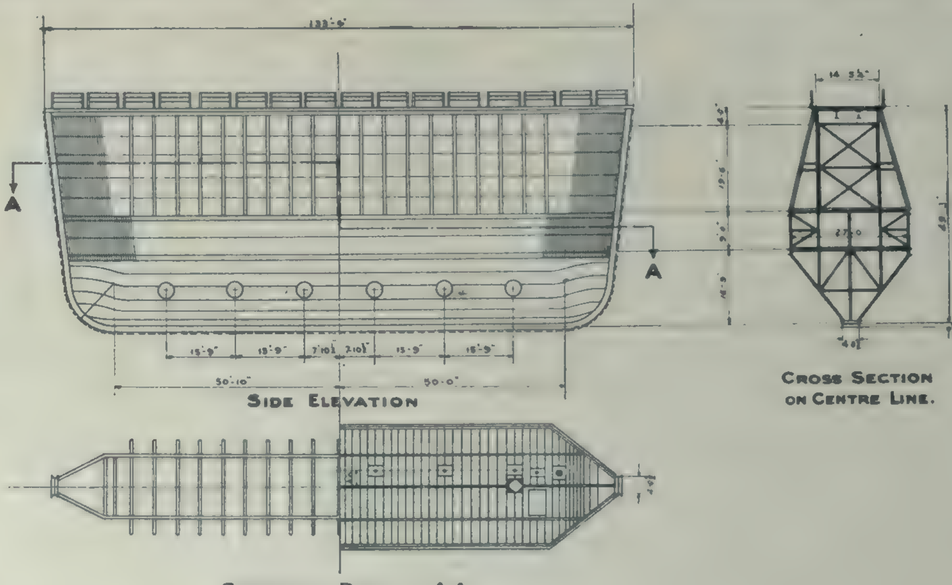
The approximate quantities of the materials in the principal items entering into the construction are:

Rock excavation above and below coping	342,000 c. yds.
Submarine rock excavation in channel	65,000 “
Dredging entrance channel	530,000 “
Concrete	100,000 “
Granite steps, altars and quoins	140,000 c. ft.
Steel beams, reinforcing bars and manhole covers	150,000 lbs.
Cast iron for roller casings and sluice valves	125 tons
Cast steel for caisson rollers	65 “
Gun metal for caisson roller and valves	4,500 lbs.
Cast iron in keel blocks and bollards	990 tons
Forged steel spindles for rollers	11,000 lbs.
Bricks for chimney and flues	345,000
Fire bricks	125,000
Cribwork in approach piers	63,300 c. yds.
Concrete in approach piers	13,300 “

Steel in rolling caisson	930 tons
Total weight in rolling caisson and machinery	1,125 "
Steel in floating caisson	960 "

The work was started in May, 1914. The concrete retaining walls on each side of the dock, specified to be built from the natural rock surface to elevation +24, and intended to prevent seepage through the filling, were completed during the season's work, as well as the cofferdam between the outer ends of these walls. Rock-drilling in the prism of the dock was also carried on in the part not affected by tides. The largest part of the drilling as done by two well-drillers, the holes being sunk down to grade and plugged for future blasting. The average depth of perforation for each drill was about 80 ft. per day, although as much as 130 ft. was done occasionally. Ten or twelve ordinary steam drills were also used on the work.

The rock consisted of hard shale, irregularly stratified, at an angle of about 45 degrees. Considerable rock slides occurred on the west side of the cut, which necessitated a much larger quantity of concrete for the dock wall on that side; also the use of rock bolts, to prevent the sliding tendency of this wall. Steam shovels and dump cars were used to remove the blasted rock, which was used for filling, whenever required, on the government property.



Elevation, plan and cross-section of floating caisson, Champlain Dry Dock, Quebec.

The cofferdam was built of timber cribwork, 20 ft. wide, sunk in an average depth of one foot of water, at low tide, and built to the elevation of three feet above high tide; a layer of concrete was deposited along the bottom of the outer face, and this face was sheathed with plank.

The floor and walls of the dock are built of concrete, the mixture being 1:3:5. All exposed faces are finished with a fine concrete of 1:2:4 mixture for a thickness of six inches. The concrete for the walls and the floor was cast in alternate sections of approximately 30 feet, with expansion joints.

All the cement used was subjected to a laboratory test. Apart from other requirements, the tensile strength was required to be 600 pounds per square inch after 27 days' immersion, for neat briquettes, and 275 pounds per square inch for 1:3 mixture.

The steps at the top of the walls are built of granite, with treads and risers of 12 inches; the altars are 2 ft. 6 in. wide, and consist of granite 12 in. thick, tailing 9 in. into the concrete. The caisson stops of both entrances and all culvert openings are built of granite.

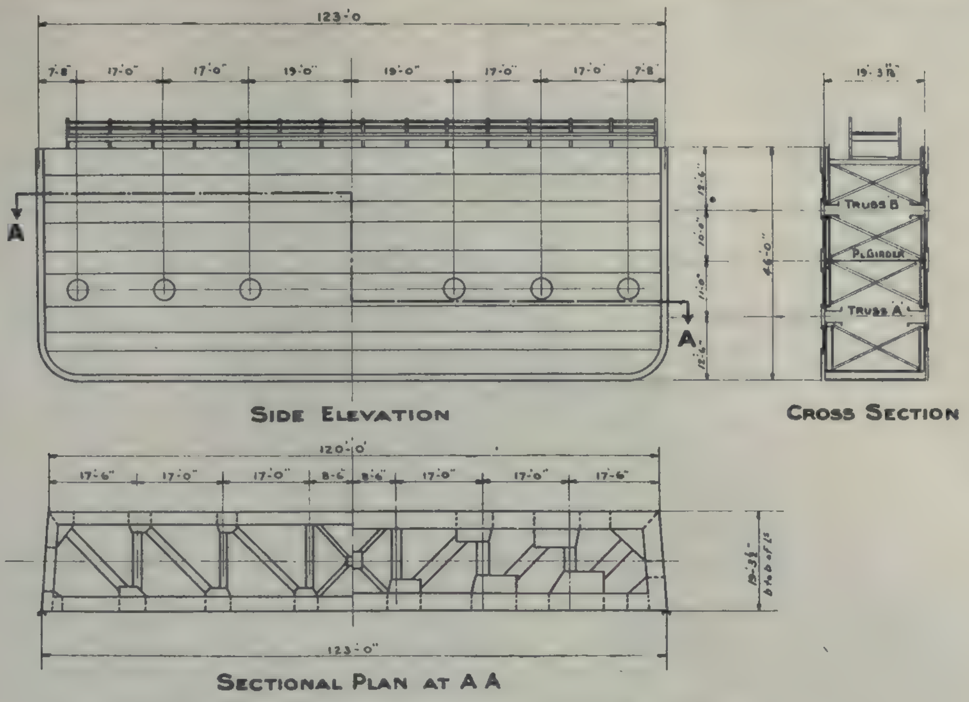
The floor is 5 ft. thick and finished level from end to end; the sides slope down 6 in. to the side gutters. The floor is provided with three strips of granite slabs, 18 inches thick, intended to receive the cast iron keel and bilge blocks. The middle strip is 10 ft. wide and level; the side strips are 9 ft. wide.

In order to prevent the possibility of hydrostatic pressure under the floor and behind the side walls a system of drains is provided that will take the seepage water to the sumps.

There are twelve stairways from the top of the walls to the floor of the dock, two at each end of the two compartments and two halfway between the ends of each compartment. Four timber slides, built of granite slabs, 18 in. thick, are provided alongside the last set of stairways. There are also eight ladders, four on each side of the dock, that may be used to reach the floor. These are built with galvanized iron gas pipe, and set in recesses in the walls.

The coping of the walls stands at elevation + 25, or 7 ft. above high tide. They are provided with the ordinary cast-iron bollards set in concrete blocks, 60 ft. apart. There are nine electrically-driven capstans with 15 horse-power motors, four on each side of the dock and one at the head.

The keel blocks are each built of three pieces of castings, the middle piece being wedge-shaped, so that it may be knocked out and the block removed from under a ship when in the way of repair work; the upper part of the top piece of casting is provided with a piece of white oak tenoned into the casting. All rubbing faces are planed true and smooth. The keel blocks are 4 ft. 4 in. long and 2 ft. 3 in. high. On top of these are placed temporary hardwood timber blocks, to obtain the required height above the floor. It had been intended to build bilge blocks, so arranged as to slide under the bilge of vessels. However, this was objected to by the British Admiralty, who insist on having all



Elevation, sectional plan and cross-section of rolling caisson, Champlain Dry Dock, Quebec.

blocks made of the same pattern, so as to enable building a bed that will conform to the bottom of the vessel.

Caissons

The outer entrance is closed by a rolling caisson, built of steel, and operated by an electric motor of 125 horse-power. The bottom is provided with two heavy scantlings of steel, resting on flanged rollers, 3 ft. in diameter, placed at 8 ft. centres. These are made of cast steel and bored to receive bronze bushings. The forged steel spindles, 4 in. in diameter, are also provided with bronze sleeves. The cast-iron casings, containing the rollers, are set in the concrete altars, on each side of the caisson berth and chamber. At an elevation of 15 ft. 9 in. above the sill of the dock the rolling caisson is provided with 6 culverts, 42 in. in diameter, closed by sluice valves that are operated from the upper deck by a 15 horse-power electric motor, driving a longitudinal shaft provided with the necessary gearing; and, by means of clutches, any one or all of the valves may be worked. The culverts are used for flooding the dock. The caisson is divided horizontally by a water-tight deck at the elevation of 23 ft. 6 in. above the bottom, forming the ballast and tidal chambers. As the tide rises the sea water comes on this deck through valves in the outer face of the caisson, which are kept constantly open during the summer to prevent the caisson from floating. A sufficient quantity of ballast is provided, so that the total weight of the structure resting on the rollers is approximately 150 tons. During the winter, when the dock is not in operation, the lower or ballast chamber of the caisson is filled with water, which is kept from freezing by a constant jet of steam. The tidal chamber is then kept dry by closing the valves. The caisson is closed and opened with heavy chains, supported on altars on each side of the caisson recess, and passing over pulleys worked by worm gears connected with the motor. The top of the caisson is provided with a folding bridge for light traffic across the dock; as soon as the caisson starts to open, the apron and railings of the bridge are automatically lowered to allow them to pass under the flooring over the caisson recess.

The middle entrance of the dock is closed by an ordinary floating or ship caisson. When in place, the deck is used as a bridge across the dock. This caisson may also be used to close the outer entrance by placing it immediately outside the rolling caisson, where the necessary stop is provided for it. This, however, will be necessary only in cases of repairs being required to the submerged parts of the rolling caisson.

These caissons were built by the Dominion Bridge Company, under a subcontract. The mode of construction and other particulars were fully described in a paper read before the Canadian Society of Civil Engineers by Mr. L. R. Thomson, A.M.Can.Soc.C.E., Volume 30, Part I., 1916.

Boilers and Electric Power

Six water-tube boilers of 500 horse-power and two of 300 horse-power furnish steam at 200 pounds pressure to produce electric current. The boilers are provided with automatic stokers, ash and coal conveyors. The coal is unloaded from cars into a coal crusher run by an electric motor, and elevated to a hopper of 500 tons capacity, over the front of the boilers. Water-heaters are provided, but the steam is not superheated; one of the small boilers will be constantly under steam pressure to run the drainage pumps and the lighting dynamo.

The electric power consists of three direct current turbo-generators of 550 volts, one of 1,500 kilowatts, one of 750 and one of 300 kilowatts. The steam turbines are of the Curtis condensing type, built by the General Electric Company. In the large unit the turbine runs at 3,600 r.p.m. It is geared down to 360 revolutions for the generator; the second is geared from 5,000 to 750; the third is geared from 5,000 to 900 r.p.m.

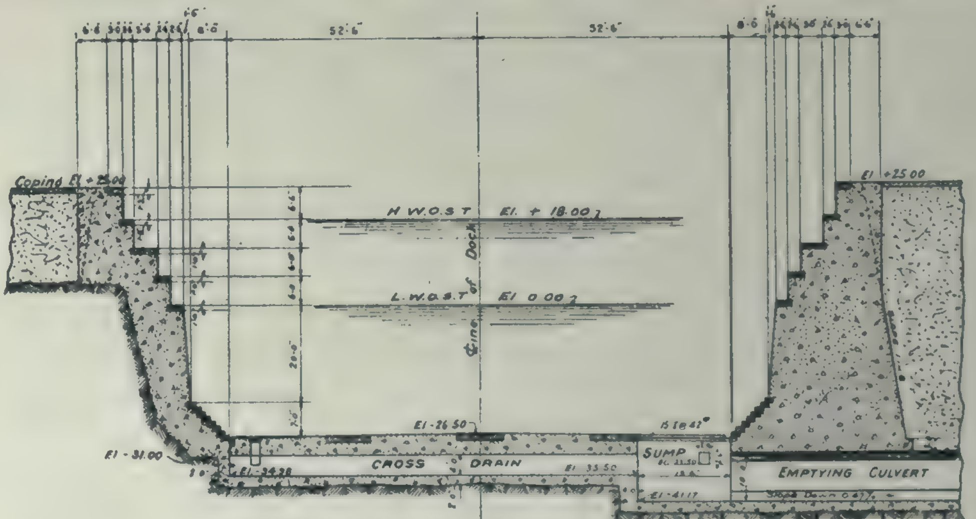
A 100-kilowatt generator driven by a high speed direct connected steam engine, furnishes the current for lighting purposes.

This power installation is more than ample for all the machinery connected with running of the dock proper. It is, however, anticipated that the whole of it will be used when large repairing and shipbuilding shops are in operation together with the pumping of the dock.

This electric installation has been criticized on the ground that the large expenditure is not justified when electric current is available from private companies in the vicinity of Quebec. When the electric installation was proposed by the writer the idea in view was that no company would be interested or willing to furnish over 3,000 h.p. at any time of the day or night for the short period of about 50 hours in the year, without interfering seriously with their general service. It had also been ascertained by personal visits to five of the principal navy yards of the United States Government that each of them has provided its own electric power for pumping their drydocks. Out of five, only one had installed alternating current machinery. It has developed since that the only electric company that could furnish the power current is not willing to entertain the proposition unless at a much greater cost to the government than the private installation can be run, including the interest on the outlay, which is approximately $240,000.

Pumps

The dock is emptied by three main pumps of the horizontal centrifugal type, each having a capacity of 63,000 gallons per minute. The bronze shafts are connected to the armature shafts of 800 horse-power motors, running at 750 revolutions per minute. The motors are built to stand an overload of 25 per cent. for two hours; the total lift will very rarely be more than 33 ft. The suction and discharge pipes are 48 inches; the water is discharged into a chamber provided with non-return valves, and to a culvert through the entrance wall outside of the caisson. The main pumps are guaranteed by the builders to deliver 63,000 gallons per minute against a total head of 25 feet. At the time of writing these pumps have not been tested as to efficiency.



Cross-section showing cross-drain, sump and emptying culvert, Champlain Dry Dock, Quebec.

Two auxiliary pumps, each of 6,000 gallons per minute capacity, driven by electric motors of 125 horse-power, will take care of leakages and seepage. These pumps will also help while the dock is being pumped. The pumps were manufactured by the Allis-Chalmers Company.

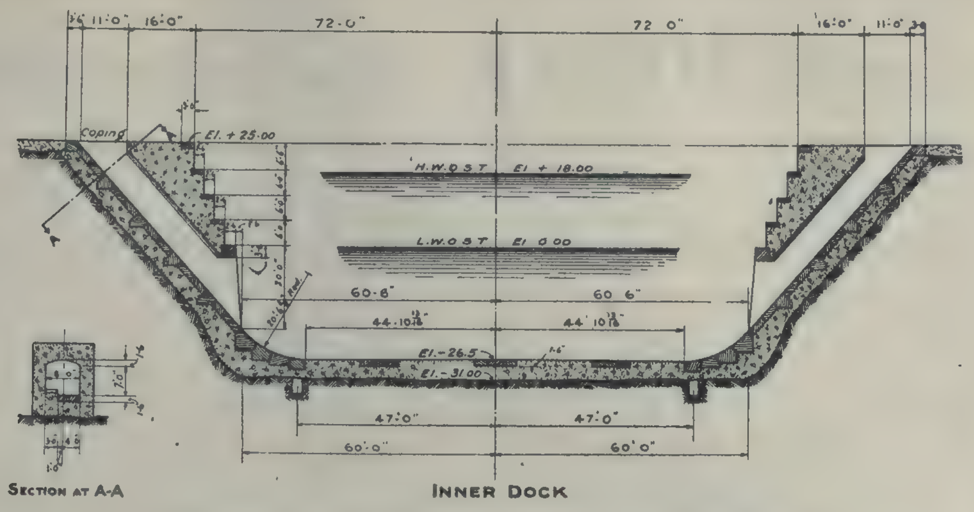
The time occupied in emptying the dock will vary according to the height of tide when the pumps are started and the size of the vessel being docked. At high water of spring tides the dock contains over 38,000,000 gallons of water. This quantity of water, however, will very rarely, if ever, exist when pumping is started. It is estimated that the average time for pumping out the dock will be about two and a half hours.

Underground culverts, 9 x 10 ft., convey the water from the sumps in each compartment of the dock to the pumps; these culverts are provided with sluice-gates, so as to permit of operating each compartment separately. The gates are operated from coping-level by 15 horse-power electric motors. The pressure against the gates may at times be due to a head of 50 ft. of water.

From the non-return valve chamber the discharge culvert is 7 x 12 ft.; it is also provided with a sluice-gate. The capacity of discharge of this culvert was obtained from Chezy's formula $V = c \sqrt{r s}$, being obtained from Kutter's formula. Under a head of 4 in. the capacity will be ample to take care of the output of the pumps when discharging in open air.

The dock is filled through the six culverts in the outer caisson, each having a sectional area of nine square feet; also two culverts, one in each side wall of a sectional area of 30 ft., the valves of which are operated by electric power. These culverts are made exceptionally large, due to the fact that each may only be partially opened until the water in the dock has reached the centre of the culvert opening, to prevent the heavy current that would result from a large opening from disturbing the beds prepared to receive a vessel; further, as the head between the outer and inner levels of water decreases the valves are fully opened, thus obtaining a large flow. The time required to fill the dock may at times be as much as four hours. The middle entrance is similarly provided with filling culverts as the outer entrance.

In order to obtain sea water by gravity for the pur



Cross-section of inner dock at timber slides, Champlain Dry Dock, Quebec.

pose of washing the floor of the dock, 6 in. pipes were laid in the concrete side walls of the dock, at an elevation of 2 ft. above low tide; each pipe has six hose connections and valves at the face of the walls, where 50 ft. lengths of 2½ in. hose may be attached for the purpose. The water is available within one hour of extreme low tide. Washing the floor is necessary, owing to the sediment accumulated while the dock is flooded.

Guide Piers

The western guide pier is 400 ft. long and 75 ft. wide; the one on the eastern side is 500 ft. long, 75 ft. wide at the outer and 200 ft. wide at the inner end. Each is built of two lines of 12 x 12 timber cribwork substructure up to 6 ft. above low water, spring tides; the outer face of each line of cribwork is built close, and sheathed vertically with 10 in. hardwood planks. The cribs facing on the channel were sunk in a depth of 30 ft. at low water, spring tides; those on the eastern side of the east pier were sunk on the natural surface of the rock. Those on the western side of the west pier, as well as those for the landing pier, were sunk in a depth of 24 ft. at low tide. From the elevation of 6 ft. above low tide the superstructure consists of mass concrete walls, stepped at the back and filled between with excavated material. The railway spur track from the I.C.R. will be extended to the end of the western pier. These piers are intended to be used, when necessary, for unloading parts of cargoes from vessels to be docked. The entrance channel has a depth of 30 ft. at low water, spring tides. The landing pier on the west side of the entrance is intended for unloading the dock supply of coal when delivered by water.

Buildings

The power-house is 120 x 100 ft., divided by a brick wall into two rooms, 120 x 50 ft., one being the boiler-room and the other the generator room. The walls are solid brick, built on concrete foundation; the roof is built of reinforced concrete slabs, supported by steel I-beams, which were procured from the unused steel of the first Quebec Bridge. The building is provided with extra large windows, with steel frames. Skylights and ventilators are also provided. The floor is concrete, overlaid with red tiles; and the lower part of the interior walls for the generator room is finished with a white tile wainscoting, 6 ft. high. Each room is furnished with water-closets and wash-basins; the water is obtained from the Lauzon village aqueduct.

A special pump in case of fire and the necessary hose are provided. The generator room has an overhead travelling crane of 15 tons capacity. The lifting is done by motor; the travelling gear is worked by hand.

The pump-house is 70 x 47 ft., with foundation walls of concrete, over which solid brick walls are built. The floor is at elevation of 16 ft. below low water, spring tides, or 41 ft. below coping. It is finished with red tiles. The interior walls up to coping level are finished with white tiles. The pump-house is also provided with an overhead travelling crane of 10 tons capacity. The chimney is 180 ft. high, built of brick, with an inner shell of fire-brick 100 ft. high. There is an air space of 6 in. between the inner and outer shells; the inside diameter is 11 ft.; the top consists of a cast-iron cap; four lightning-rods, well grounded, are provided to protect the chimney.

It may be stated that the length of the dock was decided on not merely in anticipation of vessels of, say, 900 ft. or over being employed on the St. Lawrence trade, which may not happen for a great number of years, but owing to the great number of applications received every fall from owners of moderate-sized vessels for accommodation during the winter, so that repairs may be done at cheaper rates, and the boats be ready for traffic as soon as navigation opens.

The dock is not yet quite completed. Small portions of the floor and walls at the head remain to be finished; the boilers, machinery, and pumps, although in working condition, require some final adjustment before they are tested and accepted—the rolling caisson was operated in November last—the contractors' floating plant was docked and the dock was pumped out. It is fully expected that everything will be entirely completed during the month of July next.

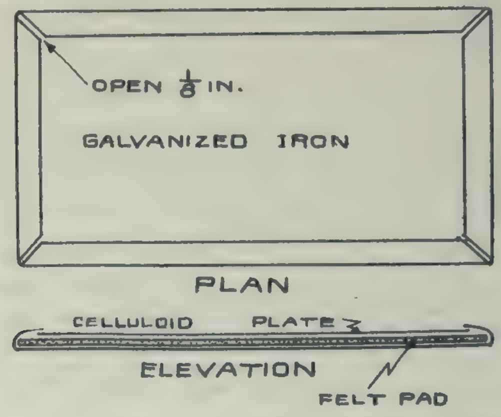
The works have been carried on by the Department of Public Works, with Mr. Eugene D. Lafleur as chief engineer, the writer as superintending engineer, Mr. J. K. Laflamme as resident engineer. Mr. S. Fortin, steel structural engineer, has had the approval of plans submitted for the steel structures. The contractors are Messrs. M. P. and J. T. Davis, and Mr. S. Woodard is their superintending engineer.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

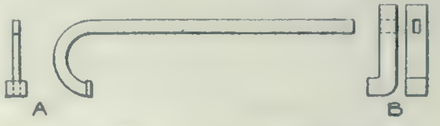
Blue Print Holder

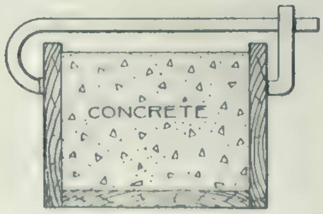
Where blue prints must be constantly referred to, a holder described by Henry J. Harms, engineer and builder, Courbevoie, France, as used in connection with the housing work done in France, is a good idea. The holder consists of a piece of sheet metal of a size to fit the drawings to be used. The edges are turned in as shown by the illustration. A piece of heavy felt is placed as a backing, then the drawing is slipped in and a piece of celluloid placed to cover it. The whole thing lies in the construction of the corners, which are not closed but left open about one-eighth of an inch, which allows the celluloid to work into place without cracking while the felt backing serves to keep the drawing and celluloid cover pressed tightly in place against the metal frame.



Clamp for Concrete Forms

An easily constructed clamp for holding the forms in making concrete structures is shown in the accompanying illustration. There are no screw threads to bother with and there is but one moving element. A contractor may have a number of these made by the local blacksmith or machine shop and use them in construction work of any character.





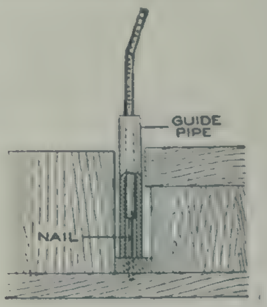
Detail of clamp.

A cold rolled bar, 1 inch by ⅜ inch in diameter and about 3 feet long should be heated and forged at one end into the shape shown on A. A short bar, 1 inch square and 10 inches long, should be fashioned similar to B. The hole in the latter should be just large enough to allow A to slip through with a close fit. It is the lever action which, pressing the diagonally opposite edges of the hole against the bar A, causes the bar B to wedge and hold.

In building a large concrete structure, a contracting company used hundreds of these clamps for holding temporarily in position the wooden forms for beams, window sills, and stairways. A great saving in time as well as money was made, as they did away with the old method of nailing wooden cross-pieces to the forms. They are easily portable and may be moved from one job to another as soon as the concrete sets.

Gas Pipe Guides Nails Driven in Close Quarters

In general building-repair work, it is sometimes necessary to drive nails in cramped places where they cannot readily be held with the hand or reached by the hammer, In such cases, take a piece of gas piping, one inch size, for example; get a slightly longer length of steel, or iron, rod that will slip loosely into the piping. Bend the iron as shown. Then drop the nail into the pipe, sliding the rod behind it, and use the pipe to guide the nail while hammering on the end of the rod.



Steam Shovel Carried on Motor Truck

Moving an 18-ton steam shovel a distance of 38 miles over country roads on three 5-ton platform trucks, and accomplishing this in eleven hours, certainly constitutes a record and demonstrates what may be done when circumstances prompt unusual methods. When, furthermore, steam was kept in the boiler the full time and the shovel ready to operate within seven hours after delivery, the record made is even more startling. The occasion for this unusual test was brought about because of the general contractors for the United States Government, in building a new bag and shell loading plant, needed a steam shovel and needed it badly and quickly. One was found in Philadelphia in the possession of a general contractor, and the Government officials proposed that I undertake the moving.—Stedman Bent in News-Record.

Transmission Line Practice — Construction and Costs

By Lieut. E. T. Driver and E. V. Pannell

The chief problems of engineering at the present day are economic ones, and the achievements of the science are worthy of note only where a true economic problem has been solved. For instance, the development of a water-power some three or four hundred miles up-country, its transmission across unpeopled terrain, and delivery at a centre of commerce, whilst effecting a technical result, cannot be classed as an engineering achievement unless the same energy will turn the wheels of industry for a lower cost than any other means and still pay interest on the capital outlay involved. Power stations have been very highly developed along economic lines, substations still more so, and the main reason why energy which can be transmitted 200 miles cannot equally well be carried 500 is simply that the transmission line costs too much.

A careful study of the different factors of cost in transmission line work is, therefore, important, and the time when every motor will be turned, every lamp lighted, and every train operated by hydro-electric energy will arrive only when the cost of transmission lines, their construction and operation have been reduced to the minimum.

Briefly summarized, the main factors in the cost of transmission line are as follows:

1. Right of way—(a) Easements or purchase; (b) clearing.
2. Surveys and engineering.
3. Material—(a) Tower steel; (b) conductors and ground wire; (c) insulators; (d) hardware and equipment.
4. Labor—(a) Distributing material; (b) digging holes; (c) setting footings; (d) assembling; (e) erecting; (d) setting insulators; (e) stringing wire and cleaning up.
5. Interest.
6. Contingencies.

The right of way item is necessarily the most uncertain of all the cost factors; in some cases it has been the practice to expropriate a strip of terrain from 50 to 100 feet in width for the whole length of the line. In the case of one very large transmission system in the South, an average of $11.42 per acre was paid for a 100 foot wide right of way for easements covering the right to erect towers and to patrol and maintain the line. This cost works out at about $15 per tower. In another similar system the cost of similar easements amounted to $1,200 per mile, which figure is also stated to cover the cost of surveys and engineering. Allowing the fairly representative figure of $500 per mile for these items, the actual cost of right of way and clearing amounts to the appreciable figure of about $700 per mile, or nearly $80 per tower. Between the above two examples most costs of right of way will be found to lie. Necessarily with the growing appreciation of the vital importance of cheap electric power it will become the regular practice for legislative assemblies to grant an act of eminent domain to all bona fide power transmission systems and to set a maximum price on land particularly where it is being held for the exploitation of the power company. The item for clearing will generally be inversely as that for easements, because the most costly right of way will be that across cleared and cultivated country.

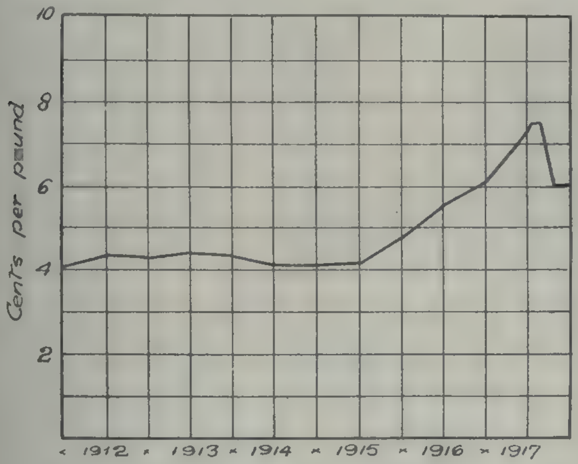


Fig. 1—Prices of galvanized steel shapes for towers during years 1912 to 1917

Surveys of the kind necessarily for power transmission lines are frequently effected at a cost of $100 per mile or less, whilst subsequent engineering expenses account for about $400 per mile. Naturally much depends upon the extent of the system, its accessibility and the type of country. It will in most cases be found that these figures are upon the high side As in every other kind of field work, a careful and perhaps costly survey may save several hundred dollars per mile on subsequent operations.

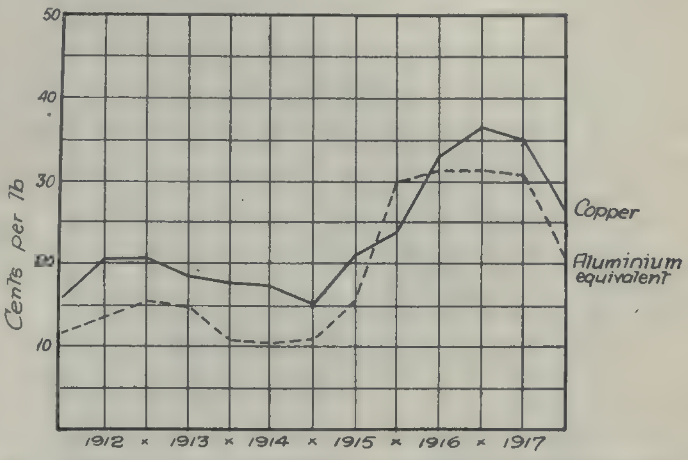


Fig. 2—Prices of copper transmission cable during the years 1912 to 1917

Turning now to the item for material, the most important is perhaps tower steel. The market prices of small galvanized steel shapes of the kind used for transmission towers, cut and punched in 500-ton lots, have varied somewhat according to the curves in Fig. 1. A great diversity of shapes in the required tonnage would, of course, involve still higher prices than these, together with more protracted deliveries. The difficulties in respect of steel, together with copper and aluminium, have been not only the prices, but the scarcity, of metal, and the congested state of the mills. Figures 2 and 3 show the price tendencies in copper and aluminium conductor cables during the last six years, and provide sufficient evidence that an increase in power rates is necessary if hydro-electric energy is still to be generated and transmitted.

In the early days of the war it was customary to speak of the time when prices would return to "normal" levels. This unsound economic argument has since been exploded, not, however, before scores of important engineering projects had been postponed awaiting the return to "normal" prices. Briefly, the cheapening of the gold standard has appreciated every raw commodity by 100, and the condition will probably obtain, with minor market fluctuations, for the next half century.

Similar comments apply to the situation as regards labor and construction costs, with the qualification that in this case economies of considerable magnitude can be effected by careful organization. It is a matter of experience that the construction costs for the extensions to a transmission system are ceteris paribus lower than those for the initial undertaking, and, with the collection of actual working data, the unforeseen elements can be reduced to a minimum and costs also diminished. The seven items of cost in the "labor" category for six different transmission lines aggregated as follows:

	Per tower.
System No. 1	$30.00
System No. 2	42.25
System No. 3	79.39
System No. 4	54.81
System No. 5	59.24
System No. 6	67.60
Average	$55.55

System No. 3 was over very unfavorable country, with considerable guying for angles. It would be found at the present time, however, that this figure is not far short of being representative, and that $80 per tower is not an unreasonable estimate for the construction costs associated with wire are included in this. The actual tower construction costs a 4,000-pound structure. Hanging insulators and stringing are estimated as follows:

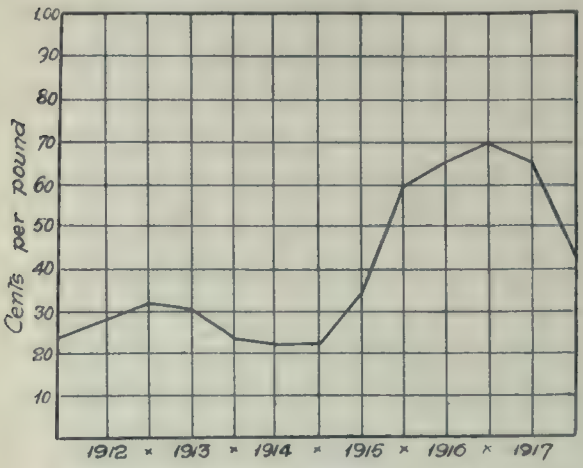


Fig. 3—Prices of aluminium transmission cable during the years 1912 to 1917

Cost of tower steel, galvanized, punched, and bundled, per pound		7.000 cents
Cost of distribution	.20 cents	
Cost of digging holes	.35	
Cost of setting footings	.25	
Cost of assembling	.40	
Cost of erecting	.30	
		1.500
Total cost of tower erected, per pound		8½ cents

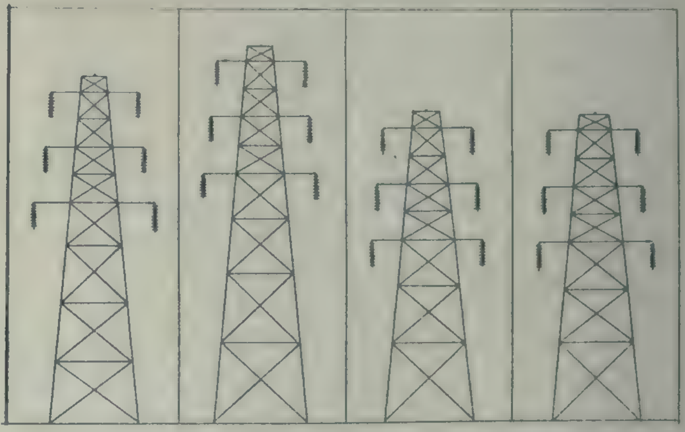
These items, it will be seen, are all dependent upon the quantity of material to be handled, and are, therefore, best expressed as a function of the net weight of the tower steel involved in the line. Setting insulators and stringing cables and ground wires are expressed by a fairly constant figure per tower:

Hanging insulators, per tower	$ 6.00
Stringing wire and cleaning up, per tower	15.00

All the above figures have been arrived at by a study of a large number of 100,000-volt installations using double circuit three cross-arm towers, spaced about 8 to 10 per mile. No intention is implied, however, to do more than merely outline the method of estimating, because the adoption of published figures for serious work would be disastrous.

For the purposes of this article interest during construction is assumed at 5 per cent. of the total cost of material and and labor, and contingencies may be considered fully taken care of by an equal allowance. Necessarily the first item will depend upon the time occupied between the placing of the first contracts for material and the first supply of power over the line. It will be lower where the line is short and where construction work can go ahead all the year round. The contingencies item amounts to a safety factor to cover work not anticipated under the heading of surveys or engineering.

It will be interesting to investigate the estimated costs of material for a twin-circuit transmission line carrying 50,000 kw. at 110,000 volts, 60 cycles, and to consider particularly the alternative use of different conductor materials. The size of cable will be 4/0 B&S copper, and the equivalent size in aluminium, aluminium-steel, and copper-clad steel. In Fig. 4 have been worked out the towers for these four cables on a 600-foot span. It will be seen that the total weight of steel per mile is not very different for copper or aluminium, but is appreciably more for aluminium-steel, and reaches a prohibitive quantity in the case of copper-clad steel. The reason is that these two latter conductors are not being economically employed at a span of 600 feet, and if these cables were all compared on the basis of 1,000-foot spans the higher tensile conductors would show up more favorably. However, in view of the fact that copper-clad calls for nearly the same height of tower as aluminium-steel, whilst the tension along the line is twice as great, the towers for copper-clad will always cost about double those for aluminium steel. If there were any saving on the conductor material itself to balance this inequality there might still be a good case for copper-clad for regular transmission work across country, but, unfortunately, the cost of this type of cable is higher than any other. It must, therefore, be considered economically unsuited for the purpose, except in the case of special river crossing spans or any locations where the conductance is of little or no importance so that a relatively small conductor can be selected.



Conductors.	Copper.	Aluminium.	Aluminium-steel.	Copper clad steel.
Size, equivalent	4/0	4/0	4/0	4/0
Maximum sag, feet	14.4	20.4	8.2	7.6
Tower height, feet	62.4	68.4	56.2	55.6
Horizontal load, pounds	15,000	10,500	26,600	48,600
Weight, standard tower	4,700	4,150	6,700	12,300
Weight, special	7,050	6,210	10,000	18,400
Span, feet	600	600	600	600
Total steel per mile	49,400	43,600	70,400	129,500
Unit price erected, cents	8½	8½	8½	8½
Total cost per mile, dollars	4,200	3,700	5,980	11,000

Fig. 4—Towers for a 600-foot span with different conductors

The average span of transmission systems ten years ago was in the vicinity of 400 feet. This value has gradually extended until the majority of long-distance systems are now being constructed, with spans of 750 to 800 feet, in favorable country. This tendency is dictating the use of materials of higher tensile strength, such as aluminium-steel, which, with the relatively small sag, call for a short tower. The tower will, of course, be heavier for its height than a structure for copper or aluminium cables, but with long spans it will be found that the net weight of steel will be less.

Mainly Constructional

East and West—From Coast to Coast

The Grand Trunk Railway bridge at St. Johns, Que., was considerably damaged recently by a rush of ice down the Richelieu River from Lake Champlain.

It is understood that work has been commenced on a new school at Rossland, B.C., to cost $80,000. Every effort will be made to complete the building this season.

City Engineer Thomas Tremblay, of Sherbrooke, P.Q., advises that in a few days work will be resumed on the construction of the trunk sewer which was commenced last year in the South Ward. The cost when completed will be $75,000.

The St. David's congregation, St. John, N.B., have decided to build a new church on Sydney Street, to replace the edifice destroyed by fire. Plans submitted by F. Neil Brodie, architect, have been approved, and as soon as detail plans are completed tenders are to be called.

It is expected that early in May, the rails of the Quebec and Saguenay Railway will be at Baie St. Paul, and will reach Murray Bay at the end of July. All the heavy work on the whole line has been completed, and probably in excess of 90 per cent. of the total work of grading has been done.

Building operations in Quebec City during the first two weeks of April were quite active, permits being issued to a value of $68,420. Of this amount, $40,000 is included for interior remodelling of the Commercial Academy building on Cook Street. This building is being made absolutely fireproof.

It is stated that upwards of $70,000 is to be expended this season on the roads in the Fort William district. Of this amount, $12,000 will be spent on grading and perfecting the Canadian side of the Scott highway, from Fort William to the Pigeon River, work on which has already been commenced.

Plans for the new military hospital, for which the city of London purchased a site, built a railway spur from the London & Port Stanley Railway, and laid a water main, appear to be in abeyance. The work was to have been completed this spring, but ground has not yet been broken, and London is unable to learn the reason.

A 4,500-ton floating drydock is to be built in the vicinity of Vancouver and the Taylor Engineering Company has been awarded the contract for the design and construction. The dock will be capable of completely docking vessels up to 4,500 tons, but repairs may be carried out on vessels as large as 12,000 tons by docking either end. The cost will be $750,000.

The housing problem at Niagara Falls, Ont., has become so serious that the city council has decided to take immediate action in an endeavor to relieve the situation. A proposal has been made to the council by the carpenters' union that all houses built or started this year in the city be exempted from taxes until the year 1920. The carpenters considered that this move would encourage building and perhaps bring in some outside capital. The council decided to refer the matter to the city solicitor.

It is understood that the Dominion Bridge Company will start work immediately on a $1,000,000 structural steel order for the T. Eaton Company, Toronto. Last year reports were current regarding the erection of a new $11,000,000 store at Yonge and College Streets, Toronto, and it was said that building operations were held over on account of the difficulty of obtaining structural steel. It is now stated, however, that the company will not wait any longer and that work is to be gone on with at once.

Personals

Major J. Colin Kemp, A.M.C.S.C.E., of Montreal, is reported to be severely wounded. He was formerly associated with Mr. R. A. Ross, and was a lecturer at McGill University. Major Kemp was awarded the Military Cross for staff work in connection with the Vimy Ridge battle.

Harry M. Marsh, for the past six years Commissioner of Industries and Publicity for the city of Hamilton, Ont., resigned that office on April 1st. C. W. Kirkpatrick, well-known newspaper man, was appointed by the City Council to the position, and assumed his duties on April 15th.

Good roads' men and many of the engineering profession will learn with regret that Mr. W. G. Yorston, Assistant Road Commissioner for the Province of Nova Scotia, has been ill for the past six weeks and his condition is such that he may be confined to his house for a considerable time yet.

Mr. William Newman, naval architect and works manager of the Polson Iron Works, Toronto, has severed his connection with that company, and is joining the United States Fleet Corporation, which has contracts amounting to several millions for ships for the United States Government. While engaged with the Polson Company he supervised the launching of 54 steel vessels.

Mr. U. Valiquet, M. Can. Soc. C. E., superintending engineer, Department of Public Works, prepared a comprehensive paper on "The Quebec Harbor Dry Dock," which was presented simultaneously before the Montreal and Ottawa branches of the Canadian Society of Civil Engineers, on April 25. This paper is reproduced elsewhere in our present issue. The Quebec Harbor dry dock, otherwise known as the "Champlain," is the largest in the world, and has been built under the direct supervision of Mr. Valiquet.

Mr. Joseph Banigan, formerly of Banigan, Mathers & Thompson, architects, writes from Terre Haute, Ind., concerning the work his company is doing in the manufacture of acetone and other solvents. Mr. Banigan is vice-president, treasurer and director of the Commercial Solvents Corporation, which has introduced to the United States a new process of manufacture, first demonstrated to be practical at the British Acetones, Limited, in Toronto. The second member of this firm, Mr. Mathers, is unfortunately in the hospital at present with scarlet fever. He was formerly with the Fourth Battalion, C.E.F., but was discharged as medically unfit. Mr. Thompson has been overseas for some time and is at present recovering in England from a shrapnel wound in his left shoulder.

Obituary

Mr. C. W. Mitchell, one of the few surviving engineers of the Canadian Pacific Railway, who ran the first survey along the valley of the Fraser through the mountains in British Columbia, died recently in Vancouver. It is 37 years ago since Mr. Mitchell went to Vancouver from his home town, Newcastle, N.B., where he was born 64 years ago.

Trade Publication

The Tiffin Wagon Company, Tiffin, Ohio, are distributing an interesting and well-illustrated booklet on street flushing, in which they point out the advantages of the Tiffin two-motor-system machines, and give details of their various types. They point out that Tiffin design permits the use of the motor vehicle for commercial haulage service, since the flushing machine is entirely independent of the propelling units, and is demountable.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Bobcaygeon, Ont.
Town Council contemplate the construction of a 12-inch tile drain. Clerk, Chas. E. Stewart.

Compton, Que.
Tenders are being received by the secretary-treasurer, J. A. Rivard, until May 18 for the construction of a gravel road, etc., for the Village of Compton. Plans and specifications with the Mayor, F. Savary.

St. Mary's, Ont.
Town Council contemplate replacing some watermains with larger ones. Chairman of committee, May W. Dale.

Shawinigan Falls, Que.
City Council contemplate the construction of a sewer system and pavements costing $100,000. Secretary, A. J. Meunier.

Sherbrooke, Que.
The city will resume work in a few days on the construction of the trunk sewer which was commenced last year in the south ward. The cost of same when completed will be $75,000. Thomas Tremblay, city engineer.

Walkerville, Ont.
Town Council contemplate the construction of pavement on Walker Road N. at a cost of $10,000. Engineer, Owen McKay, Pere Marquette Bldg.

CONTRACTS AWARDED

McMasterville, Que.
Leger & Charlton, 61 Victoria Street, Montreal, have the general contract and will be in the market for sand and cement in connection with the construction of a concrete road costing $37,000 for the Town Council.

Wallace, Man.
Boivin Bros. have the grading, and Geo. Harris, 7th Ave., Virden, the contract for concrete culverts in connection with the construction of highways and roads costing $48,000 for the Rural Municipal Council.

Railroads, Bridges and Wharves

Quebec, Que.
The Canadian Northern Quebec Railway, 160 St. Andrews St., contemplate the erection of a station. Superintendent, J. H. Davidson.

Wallace Township, Ont.
Tenders are wanted at once for the erection of a 38 ft. steel bridge, concrete abutments, for the Township Council. Clerk, David Greer, Gowanstown.

Windsor, Ont.
Plans and specifications are with the Clerk, J. A. Lagasse, Windsor, who will receive tenders until May 25 for cement foundations and piers for bridge between here and Broughton for the two municipalities.

CONTRACTS AWARDED

East Gwillimburg Township, Ont.
R. H. H. Blackwell, Peterboro, has the contract for the erection of a bridge. Engineers, James, Loudon & Hertzberg, Toronto.

Pefferlaw, Ont.
R. H. H. Blackwell, Peterboro, has been awarded the contract for the erection of a bridge near here for the Toronto & York Higway Commission. Chief engineer, E. A. James.

Quebec, Que.
The Dominion Bridge Co., Ltd., 285 Beaver Hall Hill, Montreal, have the general contract for bridge over the St. Charles River for the Department of Public Works, Dominion Government.

Roberval, Que.
Edmond Tremblay, Normandin, has the general contract for iron bridge and abutments over the Metabetchouan River at a cost of $91,475 for the Town Council.

Sackville, N.B.
Peter Clark, Summerside, P.E.I., has the general contract for baggage, mail and express building costing $7,000 for the Canadian Government Railways, Ottawa.

Toronto, Ont.
G. G. Reid, 23 Earlscourt Ave., has the contract for the erection of four bridges for the Toronto & York Highway Commission, 57 Adelaide Street E.

Vancouver, B.C.
The Davies Construction Co., 850 Hastings W., have the general contract for the erection of a $11,500 coach shop for the Canadian Pacific Railway, head office, Montreal.

Public Buildings, Churches and Schools

Belmore, Ont.
Plans are being prepared for a $3,000 manse for the Presbyterian Congregation. Pastor, Rev. N. R. Sinclair.

Canora, Sask.
Rev. Mr. Bacyneki contemplates the erection of a $6,000 dormitory for students.

Caradoc Township, Ont.
Plans are being prepared for an etomological laboratory for the Department of Agriculture, Dominion Government. Secretary, R. C. Desrochers, Ottawa.

Halifax, N.S.
Tenders will be called shortly for repairs costing $10,000, to prison for the City Council. Engineer, H. W. Johnston.

Tenders are being received by the architect, Leslie R. Fairn, Aylesford, for remodelling new galleries, entrance, etc., costing $7,000, for church for the Baptist Church Congregation.

Tenders will be called shortly for repairs costing about $11,000, to city hall for the City Council. Engineer, H. W. Johnston.

Hamilton, Ont.
The Provincial Government and the city contemplate the erection of a $300,000 technical school on Wentworth St.

The architects, Stewart & Witton, Hamilton Provincial & Loan Chambers, have been instructed to call for tenders for the erection of a $15,000 balcony and addition to hospital for the Hospital Board, City Council.

Tenders will be called shortly for alterations costing $10,000 to church for the Jewish Synagogue, 141 Hughson St. S. Architect, F. W. Warren, Bank of Hamilton Bldg.

London, Ont.
Tenders will be called May 15 for the erection of a $40,000 addition to asylum building for the Department of Public Works, Provincial Government, Toronto. Manager, Dr. Robinson.

Milk River, Alta.
Tenders will be called for the erection of a church for the United Church Congregation. Address Secretary, J. F. Coates.

Raymond, Alta.
The Department of Agriculture, Provincial Government, have secured a site on which they will erect an agricultural school. Minister, Hon. Duncan Marshall, Edmonton.

Sackville, N.B.
J. Len Allen, Amherst, has been appointed architect and tenders will be called shortly for the erection of an addition to church for the Main St. Baptist Church.

Saints Anges de Cascapedia, Que.
Tenders are expected to be called May 6 for the erection of a $10,000 presbytery for the Parish. Architect, P. Levesque, 115 St. John St., Quebec.

Sherbrooke, Que.
The City Council will install heating system, cement floors, etc., in fire stations. Clerk, E. C. Gatien, 57 Wellington Street.

Woodstock, Ont.
Plans and specifications are with the Clerk, Jno. Morrison, who will receive tenders until May 3 for concrete foundation, plastering, painting, masonry work, etc., in connection with repairs to isolation hospital for the City Council.

CONTRACTS AWARDED

Caistor Township, Ont.
Hall & Tambling, Dunnville, have the general contract for $5,000 school for the School Board.

Grantham Township, Ont.
The following contracts have been awarded in connection with the erection of an addition and alterations to school at a cost of $5,000, for School Section 8, Grantham:—Masonry, roofing and plastering, J. Nichols, Irene Street; carpen-

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Contractors Plan to Crop 270,000 Acres in 1919

At the Montreal Rotary Club luncheon, a few days ago, Mr. J. P. Anglin outlined the project of utilizing contractors and contracting equipment in agricultural work and took the Rotarians into his confidence with regard to his reception by members of the government, financiers, contractors, agricultural men and others concerning the project. He said that he had met encouragement of the most inspiring kind from nine out of ten of the men approached. The opinion was generally expressed, however, that the plan should be taken up by the federal government, as it was of so vast a nature that the various difficulties in the way could only be removed by the highest authority in the country.

Mr. Anglin said that the project was to work the land in groups of 12,000 acres each. Forty-five men were enough to operate a group of that magnitude. It had been proposed to start sixty of those groups this year, but so much time had been lost that only thirty of them could now be undertaken. If a few more weeks were lost the project would have to be cut out entirely this year. One contractor could operate several groups of 12,000 acres, with a superintendent over each. The money needed was the great drawback. The farm machinery, the contractors' equipment and organization, the idle lands; the best expert agricultural guidance in the country could all be obtained, but the money was the hard thing to obtain.

The present proposal to break 30 groups of 9,000 acres each, or 270,000 acres, this year would require $4,500,000, and next year twice that, so that $13,000,000 would be required. There would be no crop until the fall of 1919, but at the end of four crops of what would be broken this year and three crops of what would be broken next year the return to the government would be $40,000,000 cash, out of a $13,000,000 investment, and that on a conservative estimate of the price of wheat by the government's own experts.

Mr. Anglin's figures of profit may look a little bit rosy to many a practical farmer, but Mr. Anglin is certainly a practical contractor and should know what he can do with his equipment. Possibly he may not be making due allowance for bad seasons, as the figures given are not sufficiently in detail to show just how these totals are reached. However, at the present time cost of production is much less important than quantity. If it is true that a world food shortage threatens and that food may be the determining factor in the war, then the value of an extra 270,000 acres of wheat is not to be measured in dollars and cents so much as in "calories.". Mr. Anglin's scheme is well worth the support of the Dominion Government. Prompt action, however, is essential. The country needs a food "producer" quite as much as a food controller, and in proportion as the former becomes efficient the necessity for the latter would gradually disappear.

Better Dwellings For Industrial Workers

The question of industrial dwellings in relation to large plants has lately received considerable attention in the Province of Quebec. The efforts to give better accommodation have been particularly notable in the case of the pulp and paper companies, where comparatively recent developments as to output have made it more easy to establish housing schemes.

The Laurentide Company, of Grand'Mere, has been a leader in this direction, and Mr. F. A. Sabbaton, assistant manager, considers that this phase of work is as important as mill efficiency. It is part of an educational process designed to make the men good citizens. The company has gone farther than erecting model residences—it has constructed and operates a hotel, provides club houses for the employees, maintains a free school, together with skating rink, tennis courts, playgrounds, golf links, and a large farm and truck garden. Mr. Sabbaton is of the opinion that, apart from the educational value to the general community, such a scheme is profitable to the company. It provides means for the men to become more efficient, and, of course, capable of earning more for themselves, and at the same time engenders a feeling of contentment which binds them to a particular locality. This ensures a positive supply of efficient help, in place of transient labor, discontented and always on the lookout for an opportunity to move on.

A well planned housing scheme appeals in particular to men with families, and the added attractions such as have been outlined, are inducements for men to make a given town their permanent home.

The St. Maurice Paper Company, Three Rivers, and the Donnacona Paper Company, Quebec, P.Q., are following the example of the Laurentide Company, and have drawn up plans for industrial dwellings. The cottages of the first-named concern will be of frame construction, with concrete foundations. The dwellings of the Donnacona Company are to be of two storeys and a basement, stucco construction. The heating will be by means of a central system, which will supply all the houses.

The Abitibi Company, with its mills in Northern Ontario, has built a model town, designed not only to give its employees first class accommodation, in place of the shacks which would be inevitably constructed if the iniative were left to the men, but also to retain the help. The Kipawa Fibre Company, which proposes to build a very large mill at Temiskaming, has under consideration the laying out of a model town. Surveys have been made, and a scheme drawn up, with the assistance of Mr. Thomas Adams, of the Conservation Commission.

In another direction the Shawinigan Water and Power Company has done good work at Shawinigan Falls, P.Q. This town has developed at a great rate, owing to the location of industries attracted by the abundant supply of cheap power. The company has put up a large number of model dwellings, and has also expended a considerable sum in the way of providing accommodation for recreation. The president of the company, Mr. J. Aldred, has donated a technical institute, and two of the subsidiary concerns, the Canada Carbide Company and the American Electro Products Company, are building clubs, each to cost about $10,000.

In the West, the Taylor Engineering Company, Vancouver, contemplate the laying out of a model village at Point Grey, consisting of 225 residences, with a central heating system. The plans include the construction of roads, sidewalks, sewers, and water mains.

The fact that the companies responsible for the schemes have ample capital and build without making rental profit a primary consideration, has the advantage of enabling well designed and well built houses to be erected and let at a low rental. The main object is to provide convenient dwellings, to make the men comfortable, and to give pleasant surroundings in the shape of gardens, etc. The companies do not look upon the houses as revenue producers, and are therefore able to expend considerable amounts in the way of extra accommodation which would not be possible if the capital outlay was on a purely commercial basis. This makes for substantial building.

Efficiency in Highway Drainage

By N. B. Garver*

WATER is the worst enemy of good roads. A water-soaked subgrade precludes the possibility of a permanent road surface just as surely as quicksand under a bridge pier makes the superstructure unstable. An earth road that is good when dry may become very bad when it is soaked with water and has been broken up by the tramping of horses' feet and the wheels of vehicles. In winter and spring the freezing and thawing of the water in the subgrade effectively destroy any hard surface that may have been formed at a more favorable season. If efficient drainage were provided this usual "break up" of the roads would not occur.

Good drainage is an absolute necessity in any kind of permanent road improvement. The water from rainfall must not only be gotten off the road surface into the side ditches, but it must be gotten out of the side ditches into the natural watercourses so that it will not penetrate into the subgrade. It is not unusual to see earth roads well crowned and free from ruts, but the side ditches uncared for and the culverts so obstructed that it is impossible for the water to get away except by evaporation or percolation.

Highway superintendents must awaken to their responsibilities and take advantage of every opportunity to secure the best roads possible with the funds at their disposal. Drainage structures such as culverts and bridges must be built in order that vehicles may pass along the roads safely, and it requires only a small additional sum to keep these structures free from obstructions and in condition to permit the water to flow freely.

It is usual to permit the weeds to grow undisturbed along the public highways during the summer months, and by the end of summer the entrances and outlets of culverts and small bridges are hid from view by this luxuriant vegetation. If the weeds, perchance, are cut they are permitted to lie upon the ground until the first freshet washes them against the entrance to the nearest culvert; and the flow of water is almost if not entirely stopped. Drainage structures obstructed in this way are a hindrance rather than a benefit.

The late fall and early winter should be marked by energetic action on the part of road superintendents. All obstructions should be removed from the waterways. All drainage structures should be made effective by the removal of all trash and debris collected at entrances and outlets. These structures should not be permitted to stand throughout the year without serving the purpose for which they were intended. Each structure represents an investment of public funds, and an investment of this sort that does not give a return is a reflection on the judgment or public interest of the official who permits it to exist.

Culverts should be constructed at the low points in the ditches, and the side ditches should be built with a uniform grade leading to them. Care should be exercised in the grading so that no low places are left in which the water may stand.

No obstruction should be permitted in the ditches. It is not unusual to see refuse dumped in the ditches along the sides of the public highways. Frequently one will see a place where the ditch has been shoveled full of earth in order to provide a place for a wagon or other vehicle to cross. Such interferences with proper drainage should not be permitted.

Drainage structures that are worth building are worth building well. It is not sufficient to dig a trench across the roadway, roll a wood box or a section of corrugated pipe into it and cover it over with a thin layer of earth. Good practice in road construction has advanced past that stage. Such methods are a waste of labor and materials. The structure should be located and built with care. It should be at the proper elevation at the inlet so that the water can enter it freely and none be left standing in the side ditch. The outlet should be free from obstruction so that there will be no interference with the flow of water from it. Permanent end walls of masonry should be constructed in all cases. These walls should be long enough and high enough to protect the ends of the pipe, to properly retain the earth fill over the culvert, and to protect the grade from wash. The walls should be of sufficient depth so that freezing of the soil will not disturb them.

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* Associate in Civil Engineering University of Illinois in "Good Roads."

Municipal Finance—Its Relation to Pavement Construction and Renewals

By Chas. A. Mullen*

AN article appearing in a recent trade publication, by Mr. George C. Warren, opens again the controversial subject of how we shall pay for our pavements. One possibility not dealt with by Mr. Warren is charging them to the public through a wheel tax, levied by the city, county, or state. The writer would like to see this idea fully exploited, or to learn where it is in vogue and how it is working, if at all.

Why do we build roads—and pave them? For wheels. No other reason. Were it not for vehicular traffic—other than bicycles and baby carriages—sidewalks and footpaths alone would serve our purpose. And, since we build the pavements for the wheels, wouldn't it be logical to pay for them through the wheels?

Some disgruntled person may remark at this point that we have paid for most of our pavements "through the nose." Or some critic may suggest that, if we pay for our pavements through the wheels, "Why should we not pay for our sidewalks through our shoes?" The first may be true and the last may not be so foolish as it at first seems; but at present hadn't we better stick to the wheels and the vehicles they support?

It has always seemed to the writer that a tax should be collected through a locical channel. At present we are fooling ourselves very badly as to the cost of highway transportation. A railway must maintain its roadbed and collect the cost thereof in its freight charges and passenger fares; while an autobus line, delivery wagon or auto truck, or even a passenger automobile, does not pay for its roadbed, and the expense thereof is not figured into its cost of operation.

It is true that in some of the states they are taxing automobiles and using the proceeds for road maintenance. This is a step in the right direction, but why not carry the principle to its logical conclusion by securing all the money for road building and maintenance through a wheel or vehicle tax? If roads are for vehicles, and vehicles alone, why should the general city tax, or the abutting property, pay for them, instead of the owners of the vehicles, to whom the wheel tax would be charged? They, in turn, would charge it into the cost of their services to the community, so that, finally, it would rest, as always, upon the ultimate consumer, but through the logical and proper channel, instead of in the present unsatisfactory way.

Illogical procedure may usually be depended upon to produce illogical results. In the city of Montreal, where the writer now spends most of his time, and which pays for both its pavement construction and pavement maintenance out of the general city fund, the illogical results have fully materialized. On the whole, we probably have the worst paved streets in North America.

Because of a stringency in municipal finance, charged by some to war conditions, but due much more directly to purely local causes, quite painful for a citizen of Montreal to mention, the "city fathers" thought it wise to neglect the street pavements. Thereby they avoided spending some money from the general city fund for those particular years when these particular "city fathers" were appealing to the citizens for their suffrage, and they were happy.

Money was saved to the particular general city fund, but in doing so they wasted a lot of money for the community. After a few years of this kind of "saving," the streets of Montreal are so bad that they can be traversed neither with pleasure nor in safety. Trucking firms were, even last year, threatening to sue the city for damages, because of the excess wear and tear on equipment and the greater expense of smaller loads, made necessary through the ill-repair of the pavements.

Now, what the general city fund "saved" in dollaars and cents was paid out, many times over, in equally good dollars and cents by the vehicle owners using the streets of the city. They paid in repairs to wagons and automobiles and in excess horse-power, both in the nature of gasoline and oil and of the old animal flesh-and-blood kind, required to move a given tonnage between given points. They paid heavily, and they kicked to the "city fathers," to no purpose.

The Wheel Tax

Were the city of Montreal paying for its pavement construction and maintenance by a wheel or vehicle tax this condition would not exist very long. The vehicle owners would not be slow to realize that they could get the same results at less cost by paying their money into a proper tax fund to build and maintain pavements, rather than by paying it to the wagon-smiths, the garages, the horse dealers, and in excess labor costs to men who are swearing at the discomfort to themselves growing out of the unkept street surfaces.

Some may object to the wheel tax as a means of paying for road service on the ground that it too closely resembles the old toll roads system. To such it can be said that there were two great objections to the collection of tolls—first, too much of the amount of the tax was spent in the collecting thereof; and, second, the toll roads were privately instead of publicly owned. Of these objections, to the writer, the last only seems fundamental; the first is a matter of practical application that is overcome by the wheel tax.

Another objection that might be raised is that we are getting away from free public roads. But nothing is free; we are paying for them now, only by a differnet and less satisfactory method. Nothing that is the result of labor can ever be free. Natural resources may be, but not manufactured products, such as roads. Someone must always pay; so, why not have the burden fall equitably upon the road-users through a wheel or vehicle tax?

The writer is not ignoring the fact that so radical a change in the method of paying for our pavements would meet with a lot of opposition from the status quo. Neither does he claim to have suggested anything new; for the plan was, he is quite sure, advanced by others long ago. What he does suggest is that we really begin to think about doing something along these lines. It is a long way to Tipperary, but it is probably an even longer journey to a satisfactory method of taxation to pay for road building and paving. Let's hear what the single taxers, and others, have to say about it.

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*Director of Paving Department, Milton Hersey Co.

Sparkhall Ave. Relief Sewer, Toronto

By W. S. Harvey, A.M. Can. Soc. C.E., A.M. Inst. C.E., Engineer of Design, Department of Sewers, Toronto, and R. T. G. Jack, B.A. Sc., Resident Engineer, Department of Sewers, Toronto

The storm sewer known as "Sparkhall Avenue Relief Sewer" was constructed to relieve the congestion in the district bounded by Danforth Avenue on the north, Bain Avenue on the south, Pape Avenue on the east, and Broadview Avenue on the west. The sewer has its outlet at the River Don and terminates at Logan Avenue, with provision for a future extension to Pape Avenue, Figures 1 and 2.

Many of the sewers in this district have been laid a great many years, and, although the lateral sewers are of ample capacity to accommodate both sanitary and storm flow from their own individual drainage areas, yet the main sewers are now not capable of carrying the storm water from their accumulated areas since the district has been built up and improved.

At the time of preliminary investigation for the relief sewer, the question of location had to be decided between Bain and Sparkhall Avenues. The latter avenue was selected for two reasons, viz.: First, on account of the roadway being macadam and not brick, as in the case of Bain Avenue; on this account the resurfacing would be less costly; and, second, if Bain Avenue had been decided upon, it would have been necessary to construct two lateral relief sewers extending back to Sparkhall Avenue to drain the natural sump which exists between Millbrook and Hampton Avenues, Fig. 2.

Design

The sewers on Logan, Carlaw, and Pape Avenues extend north of Danforth Avenue, but these are relieved by the Danforth Avenue storm sewer, which flows west on Danforth Avenue and south on Winchester Drive to the River Don. That storm sewer allows three times the dry weather flow to continue southwards, so that the extra quantities had to be allowed for in calculating the height of the weirs of the diversion chambers for the Sparkhall Avenue relief.

The relief or diversion chamber at Logan Avenue differed from those at Hampton Avenue, Millbrook Avenue, etc., on account of the relief taking place at a drop manhole. Fig. 3 shows a plan and section of this chamber, the broken lines indicating the curves taken by the dry weather flow and by three times that amount. The curve for three times the dry weather flow limits the width of gap of the overflow, which is a form of leaping weir. It will be noticed that the intercepting trough is adjustable, and, by sliding it forward, the quantity passing to the relief sewer may be regulated.

The dry weather flow curve is arrived at in the following manner: The total area contributing to Logan Avenue at Sparkhall Avenue, including the area north of Danforth Avenue—130 acres. The dry weather flow from this area amounts to 1.7 c.f.s., based on a water consumption of 120 gallons per head per 24 hours and 40 persons per acre. Assuming that one-half of this is run off in eight hours, the flow will be .013 c.f.s. per acre. The brick sewer on Logan Avenue, at the point of relief, is 2 ft. in diameter, at a grade of 1 in 20, with a capacity of 42.2 c.f.s. and a velocity, flowing full, of 13.4 ft. per second. The ratio of the dry weather flow (1.7 c.f.s.) to the capacity (42.2 c.f.s.) is .04, which

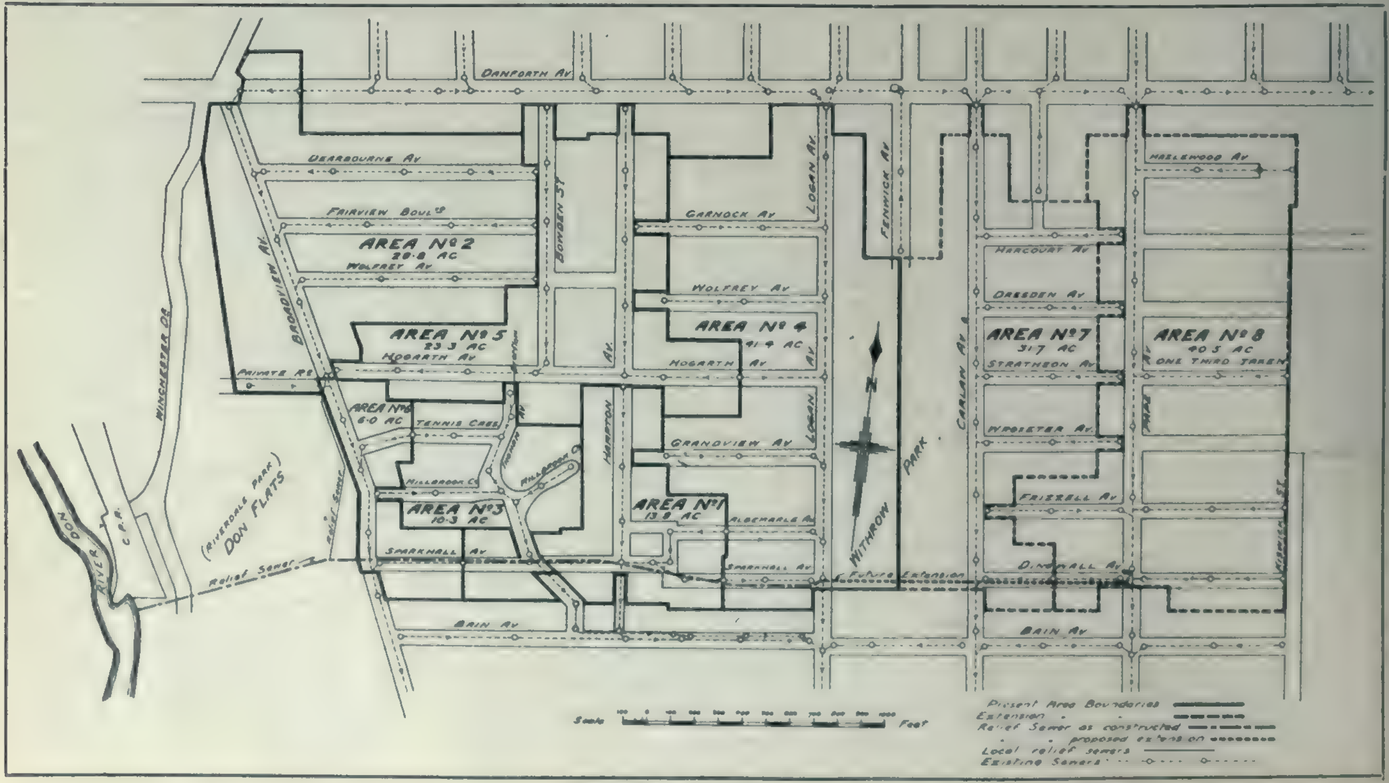


Fig. 1—Plan of drainage areas.

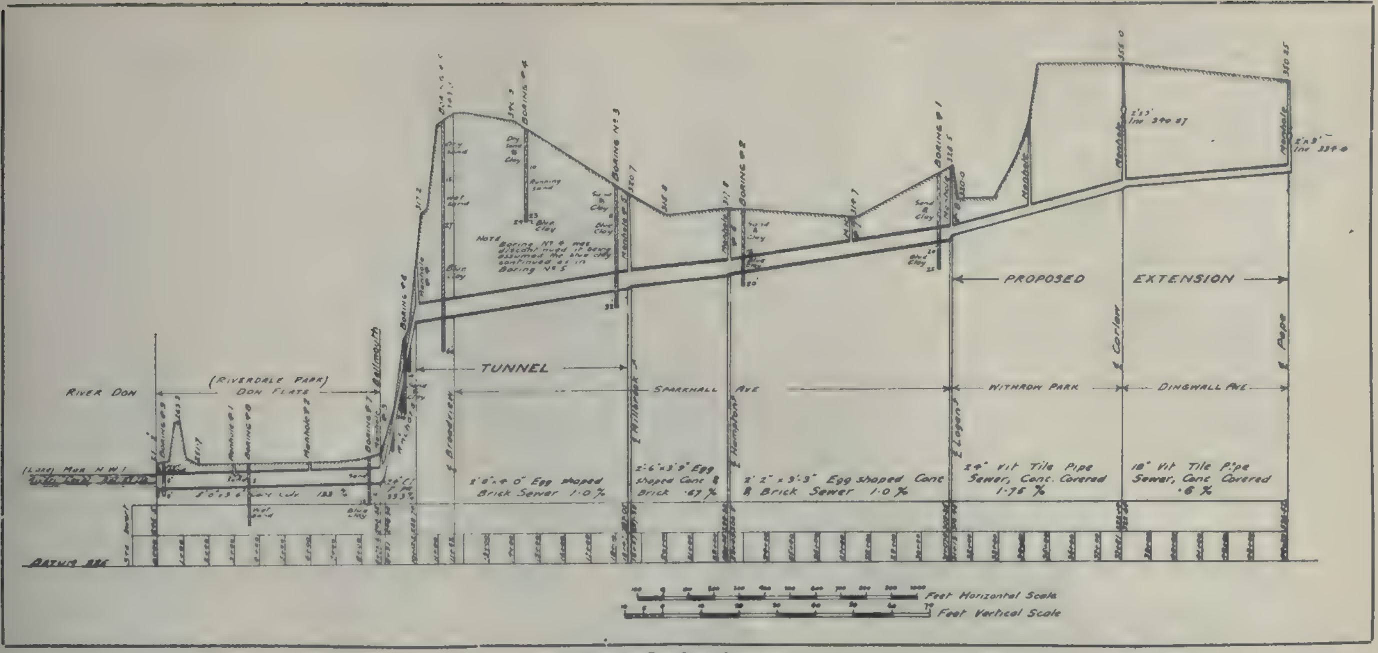

RIVER DON
(RIVERDALE PARK)
DON FLATS
TUNNEL
SPARKHALL AVE
WITHROW PARK
DINGWALL AVE
PROPOSED EXTENSION
Bellmouth
Broadview
Millbrook
Hampton
Logan
Carlaw
Pape
Note
Boring No 4 was discontinued it being assumed the blue clay continued as in Boring No 5
5'6" x 4'0" Egg shaped Brick Sewer 1·0 %
2'6" x 3'9" Egg shaped Conc & Brick ·67 %
2'2" x 3'3" Egg shaped Conc & Brick Sewer 1·0 %
24" Vit Tile Pipe Sewer, Conc. Covered 1·75 %
18" Vit Tile Pipe Sewer, Conc Covered ·6 %
Blue Clay
Running Sand
Wet Sand
Sand & Clay
DATUM 250
Feet Horizontal Scale
Feet Vertical Scale

Fig. 2=Profile of sewer.

gives a ratio of depth of flow to sewer diameter of .13, or a depth of 3.12 inches. The velocity for the above flow is 5.7 ft. per second, which, for this small depth, may be taken as being on the surface.

It will be seen that the curve is a parabola, with its abscissa parallel to the invert, the surface of the flow being the origin. As the velocity in the sewer is constant, if any distance x be taken from the surface of flow produced, then $x = vt$, and if y be the corresponding ordinate, then $y = \frac{1}{2} gt^2$; so that $t = x/v$, and $t^2 = 2y/g$ or $t = \sqrt{2y/g}$; equating these equal values, we have $x/v = \sqrt{2y/g}$, or $x^2/v^2 = 2y/g$; whence $y = gx^2/2v^2$; substituting 2gh for the value v^2, then $x^2/2gh = 2y/g$ and $y = x^2/4h$, which is the equation of a parabola whose vertex is at the surface of the dry weather flow.

The diversion chambers at Hampton and Millbrook Avenue, Figs. 4 and 5, are of the simple trough type. In each case three times the dry weather flow is carried by the trough through the chamber. During a storm any greater quantity will overflow and pass to the relief sewer. The storm flow is based on a maximum rainfall intensity of 1½ inches per hour and an average coefficient of impervious area of .35.

In all congested districts, or where special information concerning run-off is required, certain manholes are provided with float gauges, which record the backing up in the manholes from all rainstorms. In calculating the run-off of the various areas for this relief sewer, advantage was taken of float readings after rainstorms, spread over a period of several years; these records, taken in conjunction with the corresponding rainfall intensities, provided quite an accurate check on the maximum run-off as calculated.

In spite of the fact that the new sewer relieved all the sewers which it crossed, it was necessary to construct independent overflows and short lengths of local relief sewers for Hogarth and Broadview Avenues. The congestion of the sewers on these avenues was relieved in the following manner:

On the Hogarth Avenue sewer, opposite Ingham Avenue, an overflow chamber was constructed and a 15 in. tile pipe sewer laid to the existing sewer on Ingham Avenue. This overflow carried 7.3 c.f.s. from the Hogarth Avenue sewer, leaving 4.93 c.f.s. to flow to Broadview Avenue. The 7.3 c.f.s. taken into Ingham Avenue was again intercepted by the Sparkhall reilef sewer at Millbrook Avenue.

The total flow in the Broadview Ave. sewer on reaching Hogarth Ave. was 15.12 c.f.s. This, together with the remaining flow in Hogarth Avenue sewer, viz., 4.93 c.f.s., amounts to 20.05 c.f.s. On Broadview Avenue sewer, a little south of Hogarth Avenue, another overflow chamber was constructed, and a 24 in. tile pipe sewer laid on park property and connected with the Sparkhall Avenue relief sewer at manhole No. 4, just west of Broadview Avenue, Figs. 1 and 2. As three

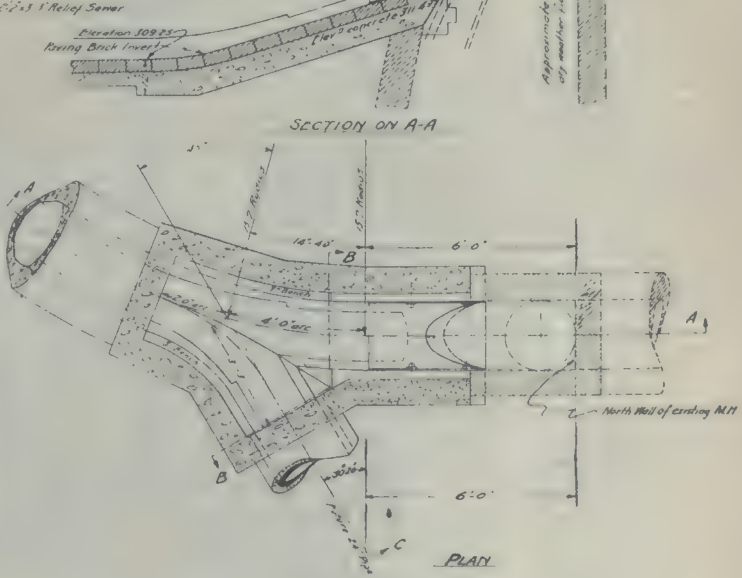


Fig. 3—Details of diversion chamber, Logan and Sparkhall.

times the dry weather flow was allowed to remain in the Broadview Avenue sewer, the balance of the storm flow, viz., 18.02 c.f.s. enters this local relief and flows to Sparkhall Avenue relief, as mentioned above. The table in Fig. 6 gives in detail all information connected with the relief sewer.

Fig. 7 shows typical cross sections of the sewer in tunnel and open cut. The standard egg-shaped section was adopted as being the most economical under the existing conditions, the ground being good blue clay, which would permit of a minimum width of trench in open cut and minimum dimensions of heading in tunnel, as practically no timbering would be required.

A cross section of the outlet across the Don Flats at Riverdale Park is shown in Fig. 8. A similar section was used under the C.P.R. tracks near the River Don, but heavier reinforcement was required in the roof slab. This section was used on account of the lack of cover available, a minimum of two feet being called for.

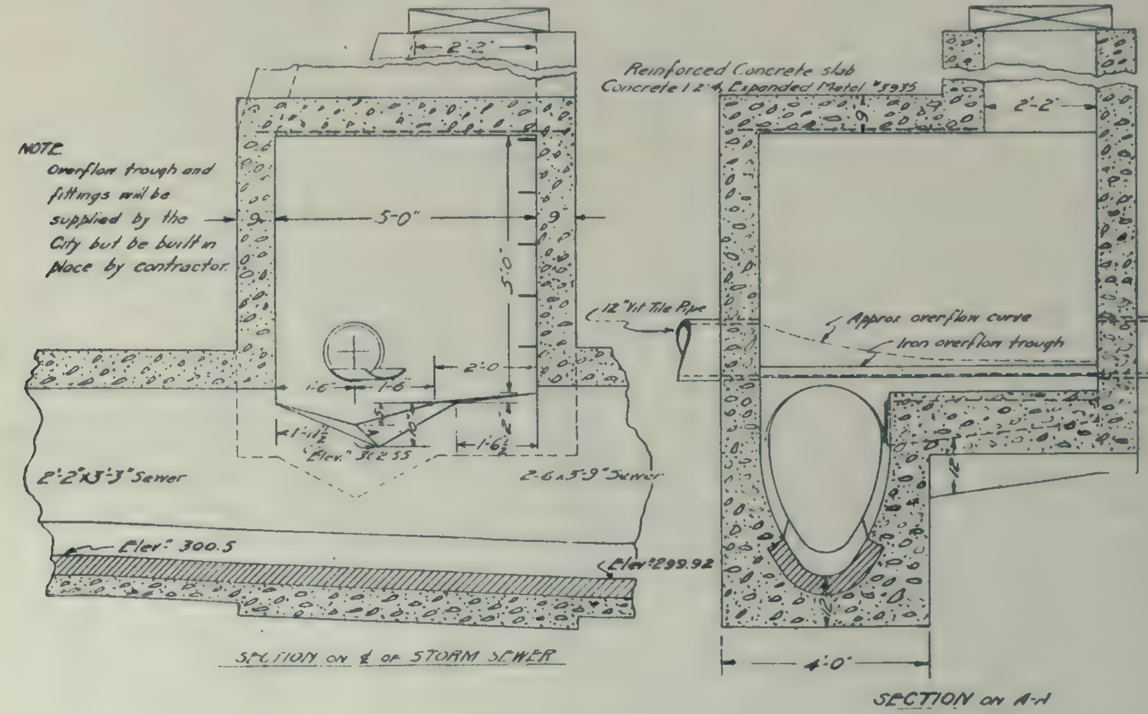


Fig. 4—Details of overflow chamber at Sparkhall and Hampton.

The usual auger and jet borings were taken along the line of sewer from end to end at the time of preliminary survey and three test pits were sunk at equal distances on the Don Flats. These test pits were sunk to the invert line. At one of these test pits, where the foundation was considered doubtful, a load test was carried out, it being anticipated at first that this length of sewer would require to be carried on piles. The result of the load test, spread over a period of fourteen days, showed practically no settlement, although a unit load equivalent to four times the combined weight of proposed fill, concrete, and water in the sewer when flowing full, was transmitted to the foundation. The roof slab is sufficient to carry a possible fill of 12 ft., or up to the elevation of the C.P.R. tracks.

The length of sewer between stations 8 + 91 and 10 + 12.2 was constructed in cast-iron pipe of 24 in. diameter, Fig. 2. It was less costly to build it in this manner than to construct deep drop manholes and tunnel short lengths of the 2 ft. 8 in. x 4 ft. egg-shaped section. However, on account of the steep slope from Broadview Avenue to the Don Flats, it was necessary to build concrete anchors and rubble drains, Fig. 9, to safeguard the possibility of the pipe creeping or being undermined during heavy rainstorms.

Construction

Under this heading it is the intention to deal with each section of the sewer as constructed, and to give a unit cost in hours, using the following key to the distribution of labor:

(A) Excavation; (B) sheeting and timbering; (C) backfilling; (D) handling surplus—excavation; (E) concrete forms; (F) placing concrete, including reinforcing; (G) placing cast-iron pipes; (J) pumping; (K) brickwork; (N) mining and sinking shafts; (P) handling supplies; (Q) handling plant; (Z) miscellaneous labor.

Reinforced Concrete Section, 3 ft. 6 in. x 5 ft.

Work was not commenced until the latter part of the summer of 1916, so that the water in the Don River, which was to be the outlet for the sewer, would be at its lowest elevation. Even with this condition, it gave the contractor a certain amount of trouble. Construction was carried on from the Don to the C.P.R. tracks; here a break was made and resumed on the other side, where, owing to the porous nature of the ground, considerable water was encountered. It might be stated that this portion of Riverdale Park (Don Flats) has been reclaimed by the city with ashes and refuse, and for this reason it was specified that a 2 in. lumber decking be placed in the bottom of the trench before the concrete was poured, and that the trench be tight-sheeted and the sheeting left in place.

The work was carried on by two distinct gangs of men, each with a separate foreman. One gang attended to excavation, sheeting, handling surplus, and backfilling; the other to setting forms, placing reinforcement, and pouring concrete.

As the trench was very shallow, no excavating machine was used. The material was cast up on top,

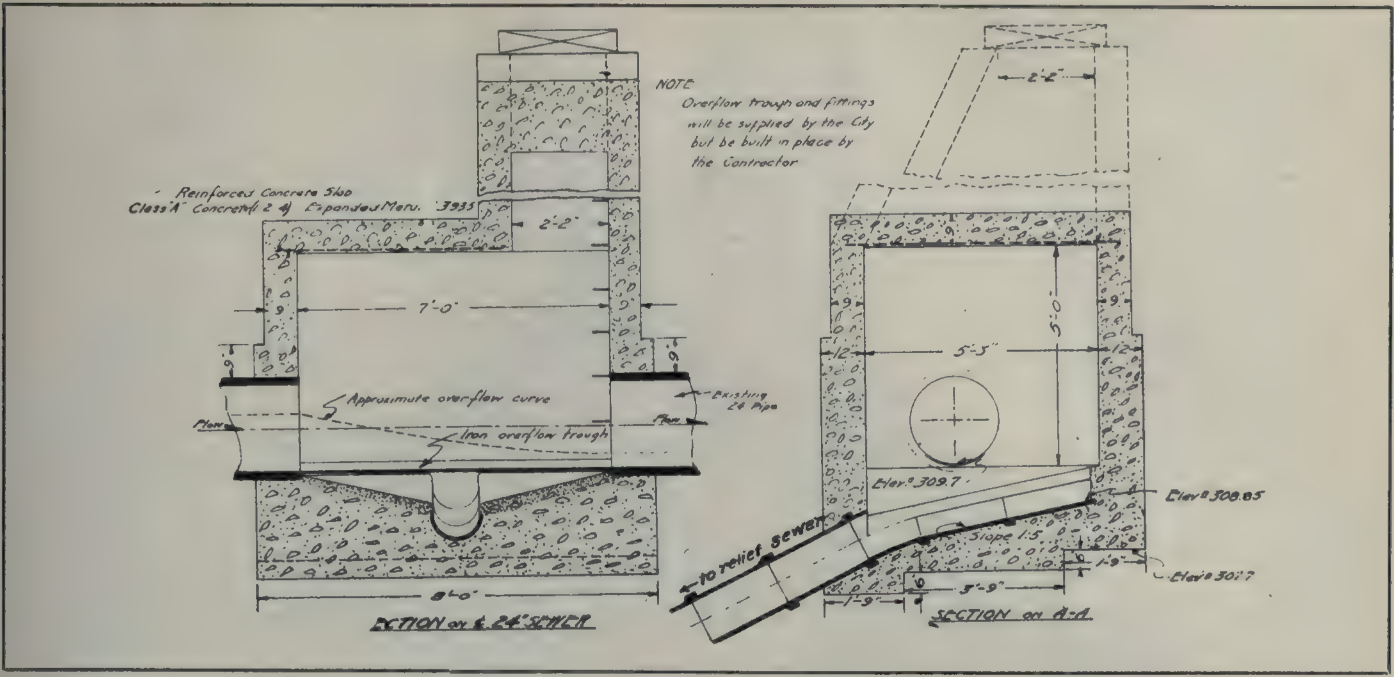


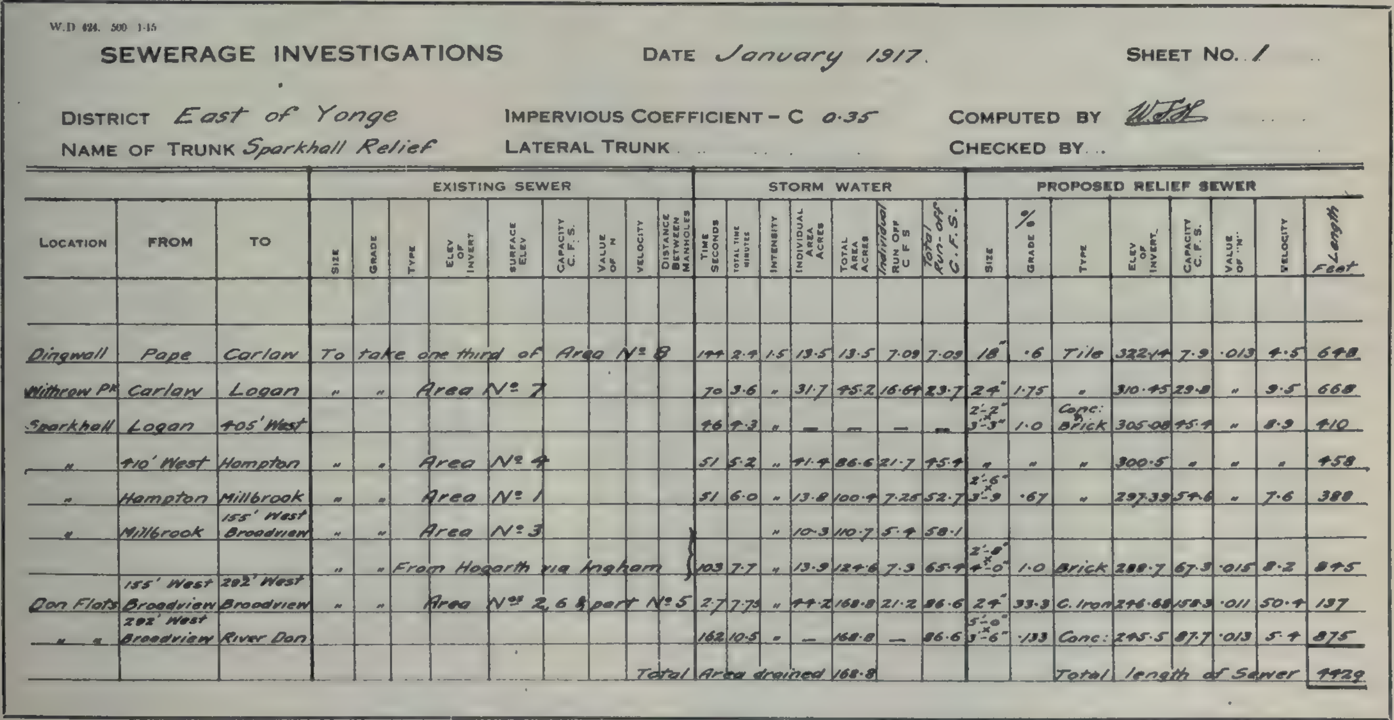
Fig. 5—Details of overflow chamber at Sparkhall and Millbrook.

where a horse and scraper removed the surplus and spread it out over the park. After the trench had been made ready and the decking and sheeting placed, the concreting gang poured the concrete for the invert, leaving it low in elevation so that 3 in. of concrete, mixed in proportion of 1 sand, 1 cement, and 3 of very fine stone, could be placed afterwards When the concrete was properly set, forms of the "knock-down" type, made of tongued and grooved sheeting dressed one side, were placed in the side walls and roof, and all the concrete poured at one running. By this method of working no delays were caused by not having any trench ready, and the concrete gangs were also able to get enough invert concreted, while waiting the required 48 hours for the arch concrete to set, in order to carry on the work successfully.

This procedure was used all the way through this section, and good progress was made, notwithstanding the fact that labor and material were scarce and that water gave considerable trouble.

After the concreting of the rough invert, side walls and roof had been completed up to the bellmouth (manhole No. 3), the portion under the C.P.R. tracks was completed and the finishing concrete applied. Before doing this, however, a thorough inspection was made, and the invert made perfectly clean, so that a good bond was assured.

While the concrete gang were doing the finishing



W.D. 424. 500 1-15

SEWERAGE INVESTIGATIONS DATE *January 1917.* SHEET NO. *1*

DISTRICT *East of Yonge* IMPERVIOUS COEFFICIENT – C *0.35* COMPUTED BY

NAME OF TRUNK *Sparkhall Relief* LATERAL TRUNK CHECKED BY

			EXISTING SEWER									STORM WATER							PROPOSED RELIEF SEWER							
LOCATION	FROM	TO	SIZE	GRADE	TYPE	ELEV OF INVERT	SURFACE ELEV	CAPACITY C.F.S.	VALUE OF N	VELOCITY	DISTANCE BETWEEN MANHOLES	TIME SECONDS	TOTAL TIME MINUTES	INTENSITY	INDIVIDUAL AREA ACRES	TOTAL AREA ACRES	Individual RUN OFF C F S	Total Run-off C.F.S.	SIZE	% GRADE	TYPE	ELEV OF INVERT	CAPACITY C.F.S.	VALUE OF "N"	VELOCITY	Length Feet
Dingwall	Pope	Carlaw	To take one third of Area Nº 8									144	2.4	1.5	13.5	13.5	7.09	7.09	18"	.6	Tile	322.14	7.9	.013	4.5	648
Withrow Pk	Carlaw	Logan	"	"	Area Nº 7							70	3.6	"	31.7	45.2	16.64	23.7	24"	1.75	"	310.45	29.8	"	9.5	668
Sparkhall	Logan	405' West										46	4.3	"	—	—	—	—	2'-2" x 3'-3"	1.0	Conc: & Brick	305.08	45.4	"	8.9	410
"	410' West	Hampton	"	"	Area Nº 4							51	5.2	"	41.4	86.6	21.7	45.4	"	"	"	300.5	"	"	"	458
"	Hampton	Millbrook	"	"	Area Nº 1							51	6.0	"	13.8	100.4	7.25	52.7	2'-6" x 3'-9	.67	"	297.39	54.6	"	7.6	388
"	Millbrook	155' West Broadview	"	"	Area Nº 3									"	10.3	110.7	5.4	58.1								
			"	"	From Hogarth via Ingham						}	103	7.7	"	13.9	124.6	7.3	65.4	2'-8" x 4'-0"	1.0	Brick	288.7	67.3	.015	8.2	845
Don Flats	155' West Broadview	292' West Broadview	"	"	Area Nºs 2, 6 & part Nº 5							2.7	7.75	"	44.2	168.8	21.2	86.6	24"	33.3	C. Iron	246.68	158.3	.011	50.4	137
" "	292' West Broadview	River Don										162	10.5	"	—	168.8	—	86.6	5'-0" x 3'-6"	.133	Conc:	245.5	87.7	.013	5.4	875
											Total	Area drained				168.8					Total length of Sewer					4429

Fig. 6--Table giving in detail all information connected with the relief sewer.

Quantities and Unit Cost (as Constructed)

Length of concrete sewer (3 ft. 6 in. x 5 ft.), lin. ft.	876
Length of 24 in. cast-iron pipe, lin. ft.	120
Cubic yards, 1:2:4 concrete for roof	125
Cubic yards, 1:3:5 concrete for invert, walls and anchors	338
Cubic yards, 1:1:3 concrete for finishing	195
Cubic yards, 1:4:9 concrete for packing	9
Cubic yards, excavation	2,012
Cubic yards, backfilling	620
Surplus excavation, cubic yards	1,390
Lumber left in place, f.b.m.	38,440
Forms placed, square feet	10,500
Sheeting in trench, square feet	14,000

Reinforcing

½ in. twisted bars, pounds	4,862
No. 3, 9, 25 expanded metal, pounds	6.872
No. 3, 6, 40 expanded metal, pounds	8,293
No. 30 road mesh, pounds	4.615

Item.	Distribution.	Time. Hours.	Unit cost per sq. ft. Hours.	Unit cost per cu. yd. Hours.	Unit cost per lin. ft. Hours.
Foreman *	A	490		.24	.50
Laborers	A	2,933		1.45	2.94
Foreman	C	72		.12	.07
Laborers	C	723		1.20	.75
Foreman	D	81		.06	.08
Laborers	D	805		.57	.81
Teams	D	320		.23	.32
Laborers	E	600	.06		.68
Laborers	B	440	.003		.48
Foreman	F	700		.90	.79
Laborers†	F	1,935		2.90	2.21
Laborers	G	268			2.20
Engineer	J	607			.68
Laborers	J	135			.16
Teams	Q	42			.04
Laborers	Q	18			.02
Teams	P	300			.30
Laborers	P	340			.34
Foreman	Z	45			.05
Laborers	Z	750			.75

*This includes B.
†This includes placing reinforcing.

the excavating gang were placing the 24 in. cast iron pipes and building anchors for the support of same, so that the work in this open cut section was practically completed before the severe cold weather set in.

Two Ring Brick Sewer in Tunnel (2 ft. 8 in. x 4 ft.)

This section started at manhole No. 4, the tunnel being operated from one portal situated on the east bank and one shaft at Millbrook Avenue. Owing to the location of the west portal, it was decided to dispense with an engine and derrick for handling excavation. Tracks were laid along a terrace on the bank and the material brought from the tunnel in cars and dumped over the side of the bank, where it was spread out to make more terraces, thereby beautifying this section of the park. The material used in construction was brought to the top of the bank, where it was stored, and, as required, was lowered down wooden chutes constructed for this purpose, and conveyed into the heading in cars. By this method of procedure the expense of an engineer, engine, and coal was eliminated. At Millbrook Avenue shaft a derrick was erected to remove excavation after it had been conveyed from the heading in cars. The shaft was placed at Millbrook Avenue with the intention of tunnelling in two directions, but when the required elevation was reached it was found that this would be impossible, as the nature of the ground changed very rapidly. On the west side of the shaft it was hard, dry clay and on the east side running sand, which could not be tunnelled without the aid of compressed air, and this would be too costly. Therefore, tunnelling was only done in one direction, thereby increasing operating expenses considerably. The surplus material was carried to a nearby dump in wagons and spread by the teamster.

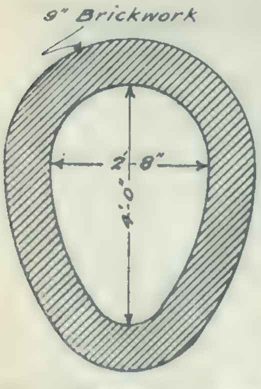
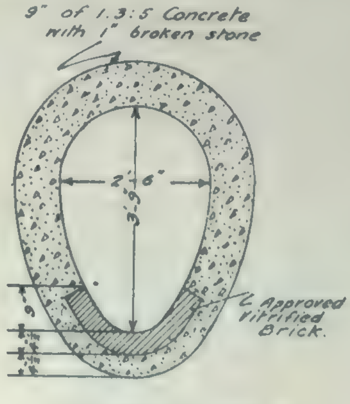


Fig. 7--Cross-section of sewer, Sta. 10 + 12.2 to 18 + 47, in tunnel.


9" of 1:3:5 Concrete with 1" broken stone
2'-6"
3'-9"
Approved Vitrified Brick.

Cross-section of sewer, Sta. 18 + 57 to 22 + 35 in open cut.

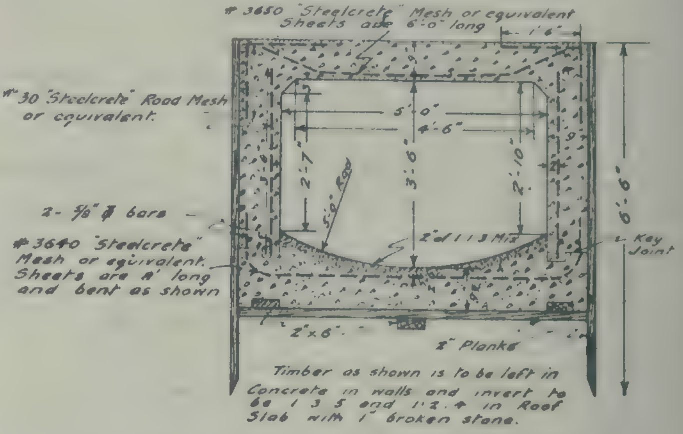

# 3650 "Steelcrete" Mesh or equivalent Sheets are 6'-0" long
1'-6"
#30 "Steelcrete" Road Mesh or equivalent.
5'-0"
4'-6"
2'-7"
3'-6"
2'-10"
6'-6"
5'-6" Rad
9"
2-⅝" ϕ bars
#3640 "Steelcrete" Mesh or equivalent. Sheets are 8' long and bent as shown
2" of 1:1:3 Mix
Key Joint
2"x6"
2" Planks
Timber as shown is to be left in
Concrete in walls and invert to be 1 3 5 and 1:2.4 in Roof Slab with 1" broken stone.

Fig. 8 —Cross-section of sewer, Station 0 + 00 to 8 + 75.6

Quantities and Unit Cost (as Constructed)

Length of 2 ft. 8 in. x 4 ft. two-ring brick sewer, lin ft.	845
Cubic yards, excavation	557.70
Cubic yards, surplus	557.70
Cubic yards, brickwork	304.20
Cubic yards, backfilling	90
Brick used	119,300
Brick packers	6,338
Cement, bags	1,365
Sand, cubic yards	140
Timber, f.b.m.	154

Item.	Distribution.	Time Hours.	Unit cost per lin. ft. Hours.	Unit cost per cu. yd. Hours.
Foreman	N	456	.54	.82
Engineer	N	509	.60	.91
Miners*	N	1,453	1.72	2.60
Laborers†	N	2,080	2.46	3.73
Foreman	K	496	.58	1.63
Engineer	K	286	.34	.94
Bricklayer	K	738	.89	2.43
Laborers	K	2,030	2.40	6.64
Laborers‡	C	207	.25	2.30
Engineer	J	75	.09	
Laborers	J	220	.26	
Engineer	Q	48	.06	
Laborers	Q	170	.20	
Teams	Q	32	.04	
Teams	D	427	.50	.75
Teams	P	235	28	
Laborers	P	135	.15	
Laborers	Z	235	.28	

*Paid on footage basis.
†Includes signalmen and muckers.
‡Backfillers at shaft and pulling timbers.

Two-Ring Brick Sewer (2 ft. 6 in. x 3 ft. 9 in.)

(a) In Tunnel

It was the original intention of the city engineer that the excavating on this section be done in open cut. The contractor, however, decided to carry it out in tunnel, owing to the frost being in the ground to a depth of 4 ft. When the work on the 2 ft. 8 in. x 4 ft. section was completed, the derrick and engine were moved to a point midway on the 2 ft. 6 in. x 3 ft. 9 in. section.

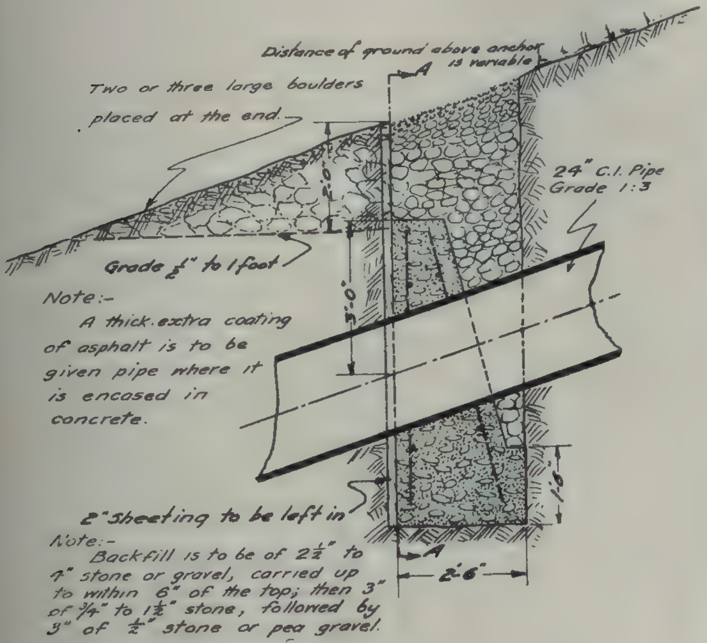

Distance of ground above anchor is variable
A
Two or three large boulders placed at the end.
6'-0"
24" C.I. Pipe Grade 1:3
Grade ½" to 1 foot
Note:- A thick extra coating of asphalt is to be given pipe where it is encased in concrete.
3'-0"
1'-6"
2" sheeting to be left in
Note:- Backfill is to be of 2½" to 4" stone or gravel, carried up to within 6" of the top; then 3" of ¾" to 1½" stone, followed by 3" of ½" stone or pea gravel.
A
2'-6"

Fig. 9—Details of anchors for 24 in. cast iron pipe, Sta. 8 + 91 to 10 + 12.2

Very good progress was made in the east heading, and the required distance would have been completed in tunnel had not the existing local sewer been encountered which necessitated the discontinuance of the work by this method and the completing of same in open cut. In the west heading a layer of wet sand was encountered before the work had proceeded very far, making it more economical to open-cut the work than to proceed with tunnelling.

The material through which the sewer ran was not as good for carrying on the work in tunnel as in the previous section and had to be close-sheeted. The work was done in the same manner as the other section (2 ft. 8 in. x 4 ft.), except that the excavated material was conveyed to the dump in cars after it had

Materials Used and Unit Cost of 2 ft. 6 in. x 3 ft. 9 in. Egg-Shaped Brick Sewer

(a) In Tunnel

Length of 2 ft. 6 in. x 3 ft. 9 in. two-ring brick sewer, lin. ft.	180
Cubic yards, excavation	61.2
Cubic yards, surplus	61.2
Cubic yards, brickwork	42.0
Brick used	22,394
Brick packers	2,230
Cement, bags	253
Sand, cubic yards	30
Timber, f.b.m.	350

Item.	Distribution.	Time. Hours.	Unit cost per cu. yd. Hours.	Unit cost per lin. ft. Hours.
Engineer	N	218	3.40	1.21
Miners	N	409	6.68	2.27
Laborers	N	433	7.00	2.40
Engineer	K	100	2.40	.55
Bricklayers	K	225	5.30	1.25
Laborers	K	446	10.60	2.48
Laborers	D	9		.05
Laborers	P	45		.25
Engineers	Q	9		.05
Laborers	Q	68		.38
Teams	Q	72		.45

(b) Open Cut

Length of 2 ft. 6 in. x 3 ft. 9 in. two-ring brick sewer, lin. ft.	208
Cubic yards, excavation	815
Cubic yards, backfilling	690
Trench timbered, square feet	7,500
Cubic yards brickwork	70.7
Brick used	33,357
Cement for brickwork, bags	350
Sand for brickwork, cubic yards	36
Cubic yards Class "B" concrete (in manholes)	28.6
Cubic yards surplus	125

Item.	Distribution.	Time. Hours.	Unit cost per lin. ft. Hours.	Unit cost per cu. yd. Hours.
Foreman*	A	260	1.25	.32
Engineer	A	235	1.13	.29
Laborer	A	1,790	8.60	2.20
Carman	A	324	1.56	.40
Laborers	B	265	1.27	
Labor	C	412	2.00	.60
Labor	D	40		.32
Teams	D	75		.60
Foreman	F	5		.18
Labor†	F	122		.42
Bricklayer	K	235	1.13	3.00
Labor	K	644	3.10	9.10
Labor	P	73	.35	
Teams	P	54	.27	

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*Including B.

†Including E.

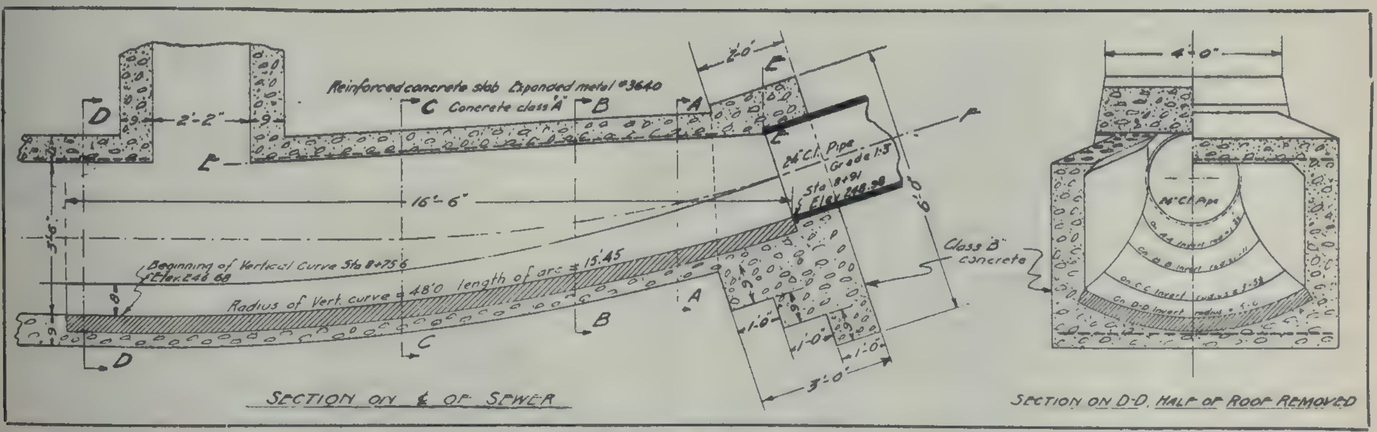


Fig. 10—Bellmouth at Station 8 + 75.6

been brought to the surface in buckets. The dump was on city property and located close to the shaft.

(b) Open Cut

When it was found impossible to proceed any farther with the work in tunnel, the balance of the 2 ft. 6 in. x 3 ft. 9 in. section was constructed in open cut. The excavating was done by hand, and the material conveyed to the rear of the work in ½-yard buckets on a travelling car, where it was dumped on the finished work as back-filling. A wet, sandy blue clay was encountered in places, which retarded progress to some degree, and, as an extra precaution against settlement, a plank decking was laid and the sewer constructed with a square base. As the work was being carried on in cold weather, it was decided to construct the sewer entirely of brick, instead of concrete, as called for in the contract. Mixing concrete in winter is expensive and not always satisfactory. The manholes and diversion chambers were built entirely of concrete, with the exception of the chamber at Logan Avenue.

Concrete Section (2 ft. 2 in. x 3 ft. 3 in)—9 in. of 1:3:5 Concrete, With One Ring of Brickwork in the Invert

In this section the excavation was carried on in the same manner as in the 2 ft. 6 in x 3 ft. 9 in. section, but much more rapidly, as the average depth of trench, which was 14 feet, was considerably less and the class of soil through which the sewer ran did not require much timbering. Just as soon as excavation was completed to sub-grade the concrete was placed in the invert and the following day the brick invert was laid.

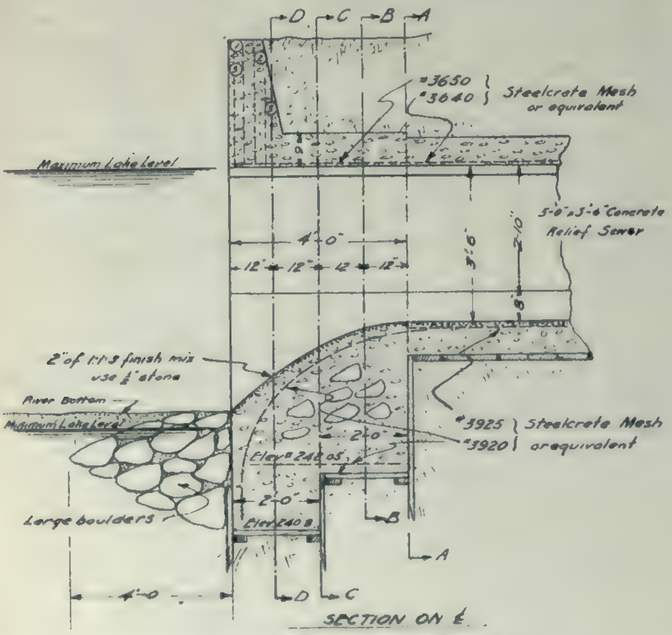


Fig. 11—Details of bellmouth at Station 0 + 00.

This was done so that the concrete forms, which were made in three sections, could be braced at the bottom. The concrete in the side walls was then run and, if possible, the concrete was placed in the arch on the same day. If this was impossible, a good key was left and the concreting proceeded with from this point the following morning. The mixing was done in a ½-yard gasoline mixer and placed by means of chutes. The absence of reinforcing simplified pouring of concrete considerably. After the concrete had set sufficiently, the tongued and grooved forms were removed and any necessary finishing was done.

At the end of this section a special diversion chamber, Fig. 3, was constructed with a leaping weir and a connection for a future extension. This chamber was constructed entirely of brickwork, which is usually found to be cheaper than concrete, as no form work is required, and therefore no waste, and the work can be continued from day to day without any delays.

Material and Unit Cost as Constructed

Length of sewer (2 ft. 2 in. x 3 ft. 3 in.), lin. ft.	878
Cubic yards of excavation	2,050
Cubic yards of backfilling	1,610
Trench timbered, lin. ft.	1,756
Cubic yards, surplus	440
Cubic yards, Class "B"	265
Brick used	11,240
Brick, cubic yards	27
Cement for brickwork, bags	126
Sand for brickwork, cubic yards	13
Cement for concrete	1,510
Stone for concrete, cubic yards	310
Sand for concrete, cubic yards	186

Item.	Distribution.	Time. Hours.	Unit cost per cu. yd. Hours.	Unit cost per lin. ft. Hours.
Foreman	A	400	.19	.45
Engineer	A	423	.20	.48
Carmen	A	845	.41	.96
Laborers	A	2,465	1.20	2.80
Laborers	B	600		.70
Laborers	C	380	.23	.43
Foreman	C	30	.02	.04
Laborers	D	20	.05	.02
Teams	D	190	.44	.22
Laborers	E	512		.58
Laborers	F	870	3.30	1.00
Foreman	F	160	.60	.18
Bricklayers	K	135	5.00	
Laborers	K	300	11.11	
Engineers	Q	12		.02
Laborers	Q	400		.44
Teams	Q	150		.16
Foreman	Q	70		.12
Labor	Z	135		.15

The work was carried out under contract by the Connolly-Agnew Construction Company, and was completed in nine months

A report of hydrometric surveys for the calendar year 1916 has recently been isued by the Department of the Interior, Ottawa. This was prepared under the direction of F. H. Peters D.L.S., M.Can.Soc.C.E., commissioner of irrigation, by P. M. Sauder, D.L.S., M. Can.Soc.C.E., chief hydrometric engineer, assisted by V. A. Newhall, B.A.Sc., and W. H. Storey, divisional hydrometric engineers. It is a lengthy publication of over 600 pages, and contains comprehensive data regarding stream measurements in the Provinces of Alberta and Saskatchewan during 1916.

While varying quantities of water are desirable for different types of concrete work, the best mixture for general purposes is one that "quakes like jelly." Such a mixture will slowly flatten out on a board or a shovel, but is not wet enough for the cement and sand which form the binder to separate from the coarse material. As thorough mixing is an important part of concrete work, it follows that it is important to prevent unmixing.

Replying to a communication from the Montreal Builders' Exchange, requesting that all tenders for public works be opened in the presence of the various competing contractors, the Hon. Carvell, Minister of Public Works, States that any interested party is welcome to be present at the time the bids are opened by officials of the Department.

Highway Construction in War Times

Jeopardizing the Transportation System of the Country under Mistaken Plea of Economy

AT a recent meeting of the Highway Traffic Association of the State of New York, the question of jeopardizing the highway transportation system of the country under a mistaken plea of war economy was thoroughly discussed. Following the discussion a number of resolutions were adopted urging the immediate necessity of more road construction. A few extracts from the remarks of Mr. S. M. Williams, President of the Highway Industries Association, are reproduced herewith as being of special interest:

Are we as a people serious as to the importance of highway transportation? Do we believe that highway transportation is necessary for the building up of the great industrial and agricultural industries of our country? It will be necessary for us to come to a definite conclusion as to these facts before we are in position to consider whether highway transportation is being jeopardized.

I will not attempt to argue with you the importance of highway transportation or the economic value of the motor vehicle, because you know both subjects as well as I do. You are also aware that if we are to have in this country the benefit of highway transportation we must prepare for it with proper and adequate highways; therefore, I will confine my remarks to the situation surrounding highway construction and maintenance in our country today.

Transportation in any country is the foundation of civilization, and with this thought it might be well to suggest that neglect of roads by any community would mean that they would be left behind in the race by more enlightened localities.

At no time in our history has there been any question of such vital importance to all industry as that which transportation occupies today. Transportation of today differs from transportation of yesterday only in the increased demand. This increased demand is the logical outcome of the growth of industry—and by that I mean all industry from the farm to the factory. True, that our becoming involved in war and the demands from the Allies for foods and munitions have increased the burdens of transportation, but regardless of war we were rapidly drifting towards the same congested conditions in transportation that exist today.

These conditions should not be charged to the inefficiencies of transportation, but they should be charged directly to those who have been instrumental in retarding or preventing the development of transportation in all its forms.

As a country we have studied transportation and its development only through one eye and that partly closed by railroad influence.

When you realize that nine different branches of our government are directly interested in highway development—the Departments of Agriculture, War, Post Office, Commerce, Interior, Labor, the Food, Fuel and Railroad Administration—and that notwithstanding our highways are just as important to our country as our railways, we find the highways without similar consideration or representation.

A great deal has been said regarding the difficulty in road building, because labor must be conserved for the industries, the farms and lumber camps. I believe there is a misunderstanding regarding the labor situation and its relation to road construction. A number of prominent farmers have recently said to me that the "farmers of this country can better afford to spare such labor as might be necessary for road construction than not to have the roads built." It is safe to assume that the cry of labor in its relation to road construction comes from those who are not in position to talk upon the subject because they do not know it.

I want to call your attention to another phase of the road building situation. We have knocking at our doors a volume of labor which should, to a large extent, be used in road construction and maintenance—not simply because of the economic benefits to be derived from the labor itself, but also from its value in physical and moral reform. I refer to the use of prison labor under proper conditions. I am personally convinced that one of the most important questions before the public today is the employment of prison labor, which, in a measure, is public property, therefore, should be utilized so as to secure the greatest good to the greatest number, including the prisoners. If we train those of the able-bodied and sound-minded male prisoners throughout the country who are not required for the maintenance of the prisons and state institutions, so that they may be utilized in highway construction, we will make one of the greatest advances towards permanent road building this country has ever known.

The question of car shortage for the movement of road building material is one requiring and demanding serious consideration. What the result will be I am not able to predict, but I am sure that, as necessity of road construction and maintenance is forced upon the government by the complete breaking down of our highways under the excessive traffic demands, ways and means will be found for the movement of necessary materials.

It is also suggested that if the question would be left to the local railroad officials and communities, in most cases the equipment could be furnished in such a manner as to not seriously interfere with the movement of other commodities. I make this statement because the suggestion has come direct from railroad officials.

> Whereas, the transportation of freight and the passage of vehicular traffic between the New Jersey terminals and New York City is at present inefficient and the provisions therefor are inadequate, and
>
> Whereas, the New Jersey Legislature has signified by its passage of adequate legislation its willingness and desire to bear its proper share of the cost of construction of an interstate highway traffic tunnel connecting New Jersey and New York City, be it
>
> Resolved, that the Highway Traffic Association of the State of New York favors the immediate construction of the New York-New Jersey highway traffic tunnel, and pledges itself to assist in securing the passage of the necessary legis-

lation by the New York Legislature authorizing the construction of the Interstate Highway Traffic Tunnel.

Whereas, the transportation requirements of the United States, due to war, can be only met by complete co-ordination of the carrying capacities of railroads, highways and waterways, and

Whereas, there has developed in the United States a tremendous increase in highway transportation for the haulage of munitions, foodstuffs and essential supplies, and

Whereas, we recognize the necessity of a federal wartime policy in respect to highway improvements, permitting the various states to immediately formulate a definite highway program, be it

Resolved, that the Highway Traffic Association of the State of New York urge upon the Federal Government and the State of New York the importance of adopting a program that will ensure adequate highway construction and maintenance so that our highways may properly carry their share of the burdens of transportation, and be it further

Resolved, that we urge upon the President and the members of Congress the creation of a centralized federal authority to determine the highway policy of our government, with power to direct the administration of that policy.

Whereas, the War Department is using many highways for military purposes, and, in many cases, army vehicular traffic constitutes a large percentage of the total traffic, and

Whereas, some highways so used are rapidly worn by army truck traffic, and

Whereas, the efficient maintenance of such highways is a necessity for the rapid and economic transportation of army supplies, be it

Resolved, that the Highway Traffic Association of the State of New York petition the Congress of the United States to enact the necessary legislation to permit the construction and maintenance by the United States Government of such highways as may be designated by the War Department as military highways.

Whereas, the number of prisoners of war to be transferred to the United States will probably rapidly increase during the progress of the war, and

Whereas, the construction and maintenance of highways of vital importance for the successful propagation of the war are prevented, due to scarcity of labor, be it

Resolved, that the Highway Traffic Association of the State of New York favors the maximum utilization of prisoners of war in accordance with the provisions of international law as labor for the construction and maintenance of interstate trunk highways and military highways under the supervision of the War Department of the Federal Government.

Whereas, it has been demonstrated that proper utilization of the motor truck parcel post service will materially increase the food supply of cities and provide for quick delivery of farm products to city consumers, and

Whereas, such service can be conducted at a profit to the United States Government, be it

Resolved, that the Highway Traffic Association of the State of New York petition the Congress of the United States to appropriate the sum of five thousand dollars for the extension of the motor truck parcel post service.

Wrecking a Concrete Building with an Iron Ball

POUNDING a reinforced concrete building to pieces with a 1,200-pound iron ball was the novel method employed when the Western Newspaper Union Building was razed to make way for the head house of the new Chicago Union Station. The building destroyed was an eight-storey structure, covering an area of approximately 107 ft. x 120 ft. It was erected in 1909, and was unusually strong, the designing live loads being 250 pounds and 300 pounds per square foot. A test of the building made before the wrecking was begun showed it to be still in excellent condition, the floors during this test withstanding a load of approximately 910 pounds of pig iron per square foot.

The lower five floors of the building were a four-way flat slab construction, the others being of flat slabs alone, the thickness of the slabs being 8½ in. and the beams 16 in. x 24 in. The concrete in the slab consisted of 1 cement, 2 sand, and 4 pebbles. The width of the octagonal column caps was 4 ft. 6 in. The short diameter of the columns was 24 in. the core being 21 in. The reinforcing in the four-way flat slab consisted of fifteen ⅝ in. round high carbon steel rods in each band, the width of the bands being 7 ft. In the columns the reinforcement consisted of 8½ in. round rods, ⅜ in. round spiral, 2½ in. pitch.

In order to facilitate the wrecking, as well as to economize in the amount of manual labor required to demolish the building, the W. J. Neuman Wrecking Company, Chicago, used a 1,200-pound ball. A wrecking outfit that would operate between the columns of the building was constructed, and consisted of a stiff-leg derrick and 40 ft. boom, mounted on a 16 in. x 24 in. platform with rollers, the ball, or "skull crusher," being carried on a single fall line. A 25 h.p. Thomas direct current electric hoist furnished the power for hoisting and swinging. The job of hoisting the various parts to the roof of the building and assembling them required several days.

The method employed in using the ball was to drop it through a distance of approximately 40 ft. on the central parts of a slab. This had the effect of shattering the concrete up to the column capitals, or to the edges of the beams. The reinforcing bars were then cut by means of an oxy-acetylene torch. The ball was next directed over the centre of the column, the blows in this instance resulting in breaking the concrete away from the rods at the base of the columns on the next lower floor to a height of 4 ft. or 5 ft. As much of the column concrete as possible was broken off in this way, after which a fire was maintained around the column base for a number of hours and then water thrown on the column. This operation caused the concrete to crack and weaken the column. Then, when the reinforcement had been cut with the oxy-acetylene flame, it was an easy matter to pull the standing mass over with a block and tackle attached to the electric hoist. The beams were brought down with the columns, and the ball was used to break up pieces of concrete too large to be loaded for hauling away. The brick walls not backed by concrete were easily knocked over by swinging the ball against them.

Of 65 men employed in wrecking the building only four were required to operate the iron ball. Ten weeks were required to raze the building, the work proceeding at the rate of a floor a week, with two weeks for the heavy construction of the basement. The total cost of demolishing the building, without taking into consideration the question of salvage, was approximately $20,000, or about 15 per cent. of the original cost of the building. This compares well with 10 per cent. on the wrecking of other reinforced concrete buildings, the difference being due to the present high cost of labor.—Concrete.

Tests of New Concrete Ship Under Seagoing Conditions

It is announced that exhaustive tests of the concrete ship, Faith, under actual seagoing conditions will be made by a committee of experts, under the direction of Mr. R. I. Wig, chief engineer of the department of concrete ship construction of the United States Shipping Board. This ship was illustrated in the April 10 issue of the Contract Record. Self-recording instruments of new design will be used to determine the nature and effect of strain on the steel reinforcement and the results of wave pressure.

Determining the Cost of Building

Some Considerations Bearing Upon the Relative Conditions Before, During and Following the War

THE cost of building before, during, and after the war is one of the important items under consideration by the up-to-date contractor. An interesting article was presented by Mr. Ernest H. Selby to the Surveyors' Institute, on April 8, 1918, the following extracts from which have special bearing on the subject:

Considering the prices of work obtaining before the war, I think it must be generally admitted that competition was keen, and that the number of jobs placed in contractors' hands without competition were few and far between. The natural reaction following the boom in the building trades some fifteen years ago was felt acutely just before the war, and prices were cut very finely owing to th supply being greater than the demand.

The accumulation of wealth necessitated finding some means for employment, and people not infrequently embarked upon schemes and businesses about which their knowledge and experience was limited, and, they, therefore, had to rely almost entirely upon the advice given them by others, without being able to verify it themselves or to assist in arriving at any general conclusions. Unless an estimator with a long and varied experience in pricing was employed, not, perhaps having the necessary data upon which to base his prices in the office, the results were somewhat erratic, and work was not infrequently undertaken at cost, or even under, the competition among the specialists and sub-contractors being especially keen.

Insufficient Data on Estimating

Of late years a great deal of time and attention has been paid to teaching the elementary and advanced stages of building construction, but I personally have not come across many, or any, young people who have been taught much of the science of estimating. A number of books have been published giving the prices of various work, but, when all is said, the numerous prices it is possible to give are merely examples, and the data given have to be applied to the actual work tendered for.

Pricing an Estimate

After gaining all the information obtainable from all sources the next thing to do is to be able to price an estimate on the information thus obtained.

This, however, is only the beginning, for many estimates are priced and but few contracts obtained. It is not sufficient for an estimator to be able to price a bill on hard and fast lines. He must keep in constant touch with the prices that are being quoted, and attempt to ascertain where and why other estimates differ from his own. Of course, there is a point reached at which jobs are not worth taking, but as the class of work asked for is constantly varying, and as the extreme cutters cannot manage to carry off all the cream of the work, some crumbs must fall at last to the fairly-priced estimate. As time goes on, even the most extreme of the cutters have to revise their prices, as contractors, and even limited liability companies, have a limit to their resources, and I suppose that even advertisement has its price. Of course, when any contracting firm is well established and is noted for good work, the competition for high-class work is not quite so keen, as such firms tendering usually know what the work is really worth and price accordingly. The practice of pricing out items to the one-sixteenth of a penny really does not make any appreciable difference in the amount of the tender, and is very likely to lead to mistakes being made in the subsequent clerical work, especially when tenders have to be submitted at short notice. If the prices are arrived at on sound and consistent principles, a far more accurate estimate can be arrived at in the time given without going into such intricacies.

High Cost of Building

The cost of building was, like everything else, high, owing mainly to the largely increased commodities required in each building, and to the more permanent and lasting, and, in some cases, extravagant means that had to be adopted to meet the competition in the buildings erected; the latest up-to-date building erected being eclipsed by more up-to-date and elaborate buildings in a few years.

Both labor and materials had been rising for a number of years, although the saving effected in the form of construction of the work might possibly partly cover the additional cost, although the cost of labor had not only risen considerably, but the output had also been reduced.

These matters, however, usually right themselves in time, as it is not to be supposed that buildings were erected unless there was some chance of their being a commercial success. Although the cost of building had increased, the rents for commercial buildings had increased in a greater proportion the more up-to-date buildings commanding far higher rents than the older ones.

Price of Building During the War

When this stupendous conflict was first thrust upon us the position was not apparently at first properly appreciated. "Business as usual" was attempted, presuming that we could carry on the war with one hand and conduct our business with the other.

This extraordinary state of things continued for about fifteen months and the prices of materials during that time, with the exception of those used for the actual carrying on of the war, did not advance to any appreciable extent, and the cost of labor for the time remained about the same. Soon, however, the enormous inroads made into the stocks of timber in the country, used in the construction of huts for the troops and other military purposes, came to be felt, and the cost of all materials that we had previously obtained from abroad advanced rapidly, owing to shortage and increased shipping freights.

Discontinuance of Private Work

When all private work had eventually to be stopped, to allow the government to carry out those enormous works which were necessary to produce the sinews of war, the prices of materials continuously advanced, and the output of labor, at least in the building trades, in a large number of cases steadily decreased. The practice of placing contracts on a percentage of profit basis did not tend to improve matters, and to meet the exigencies of the situation, most of the work having to be done in a very short time, a greater quantity of labor was employed than could be used advantageously.

The condition of things soon became chaotic. Quotations were given under all sorts of restrictions, and were subject to alteration without notice. Stocks were commandeered, and prices of all materials rose considerably, and are still rising.

In spite of the tremendous increase in price, many and heavy losses were incurred on lump sum contracts, and a very large amount of the work now being carried out is on a cost and profit basis, or, if on a lump sum, with contingent increases for rises in prices of labor and materials.

What will eventually be done with pre-war contracts that extended into the war period and the contracts taken during the war still remains to be seen, but the application of the principles underlying the Courts (Emergency Powers) Act of 1917 may, in some measure, assist in distributing the loss among the parties concerned.

I shall not attempt to deal with the prices during the war in detail, as no useful purpose would be achieved by doing so. We hope and trust they are only transitory, and will soon be buried in oblivion. It must not be overlooked, however, that the prices of materials home produced and the few that are imported are still going steadily up, and it is impossible to say how high prices will eventually reach, while advances are continually being made in the rate of wages.

Price of Building After the War

I now come to the last phase of the presumptive or speculative prices for work that will probably rule after the war is over, which, of course, will be affected to a very large extent by the conditions under which peace is made.

Taking first the cost of labor, this must be governed by the cost of living, which seriously affects the pockets of wage-earners, and will not, in my opinion, be reduced for some years to come; and I submit that only by the reduction in the cost of living can the wages of workmen be reasonably expected to be reduced.

The process of rate-cutting by reducing the scale of payment would, of course, tend to slow down the output, but if proper rates, in the first place, are arranged on an equitable basis by the employers in conjunction with the workmen, and workmen choose to exert themselves, the result ought to be satisfactory, the employers benefiting by the increased output, and the competent workmen would be enabled to earn far more with the general public benefiting to the largest extent.

The Cheaper the Work Is Done the Better for All

There were certain specialized trades before the war, such as slating and tiling, wood block floor, mosaic and other special floor coverings, gauged brick-cutting, fencing, certain forms of metal working, glazing, and many others, where men were employed always at the same thing, and thus became far more expert, where the prices at which these particular works were executed could not be done by ordinary tradesmen. Surely if the work is done, and done properly, and a proper living wage is to be earned, the cheaper the work is done the better for all.

If some sort of a scale of wages were arranged for output, which was not immediately varied directly the employers considered the workmen were earning too much, or varied to suit the requirements of those people whose one idea appears to be to do as little as possible, not only would the cost be in time reduced, but estimates could be much more closely and accurately priced.

As occasion arose the rates could be revised to suit the particular localities by mutual agreement, and I feel convinced that in this way the cost of many materials could be reduced, and a great many savings be effected in the course of working and fixing the materials at the site.

Predicted Result of the War

Considering the extensive schemes that are being launched for industrial housing and the cost of same, unless the state is going to bear a serious loss, the rents of these new houses will have to be considerably higher than the rents paid for similar houses before the war, and this again will tend to raise wages, or at any rate keep them at a high level. However, taking all these things into consideration, the increased output which ought to result from better wages, shorter hours, and better conditions of living may, when the excitement and unrest caused by the war has calmed down, result in the lowering of the cost of work considerably. Whether this happy result will follow or not has to be proved, but the enormous convulsion caused by the war may have startling results, especially when the boys of all sorts and conditions who have been so gallantly fighting for their king and country return to us again.

These great social questions do not come within the scope of this paper but they are bound to have a far-reaching effect on the prices at which buildings will be erected after the war.

The price of labor will naturally largely affect the cost of materials, and if the labor problem in the production of materials can be entirely solved by payment by results, the cost of materials ought to come down in a reasonable time to something approximating to pre-war rates.

35-Ton Granite Block Rolled from Quarry to Railroad

A novel method of transporting a 35-ton block of Texas granite to the railroad is described in Engineering and Contracting. The quarry from which this granite was taken is situated eight miles from the nearest railroad station. A poor road and weak bridges connected the two. Furthermore, there were no wagons in the vicinity capable of handling this weight, so that it was decided that the only practical method of transporting the stone was to roll it to the railroad. This was done by tying small logs to the stone with wire rope, which acted as a tire and as protection to the block. The motive power was supplied by an engine mounted on a truck which followed the path of rock. The block was moved forward by unwrapping a wire rope which had been previously wrapped around it, by winding the other end on the drum of the engine. The friction between the block and the rough road prevented it from traveling faster than desired down the grades. Several streams were crossed but no unusual difficulty was experienced. When the block reached its destination it was finished to size 7 feet square by 10 feet before being placed on the railroad car.

Would Accept Only Competent Men

The new City Commissioners of Montreal have made a good start. Three names were submitted to Judge Bruneau as arbitrators in a dispute between certain proprietors and the city as to damage caused by the alteration of street levels in Hochelaga Ward. These names were approved by the judge, but the Commissioners emphatically declined to agree, on the ground that two of the gentlemen are clerks of the Practise Court and of the Court of Appeal, and therefore cannot be called competent to determine damage to buildings and land, and the third has an action against the city, and is usually an arbitrator for proprietors against the city. In the opinion of the Commissioners the Board of Arbitration should be composed of an architect, an engineer, and a builder, such men alone being competent to make an arbitration in conformity with the terms of the agreement between the city and the proprietors. The Commissioners declined to approve of any but competent men. One million, four hundred thousand dollars, are claimed by the proprietors, while the city admits liability for $200,000. The question later came before Judge Bruneau in the Superior Court, when the city and representatives of the proprietors agreed to withdraw arbitration proceedings and quash the act of compromise on which the project of arbitration was passed."

Development in Machine Gun Practice

At a meeting of the Montreal branch of the Canadian Society of Civil Engineers, on April 25, Lieut. Ashworth described the great developments which have taken place in machine gun work since the beginning of the war. Lieut. Ashworth took the place of Lieut. Philip Bruneau, who had been suddenly ordered to South Virginia as a machine gun instructor for the United States Army and also (to use the jocular phrase of Mr. K. B. Thornton, the chairman)—had added to his troubles by getting married that evening. The speaker, who has been thrice wounded and also gassed, told of how the machine guns protected the infantry advances, by means of barrages. The British were now using the Lewis and Vickers guns, which did excellent work. The pill boxes of the Germans were constructed of reinforced concrete, with walls 8 feet thick, and could only be destroyed by a direct hit from a heavy high explosive shell. Lieut. Ashworth described the indignation of British soldiers on finding in captured pill boxes sacks and tags showing that they had been made of British cement. Referring to the German mustard gas, the speaker stated that it was very dangerous, as it had a burning effect and caused wounds which were very difficult to heal.

Good Roads in Quebec

The one million dollars voted by the Quebec Government for good roads will be allocated as follows: $150,000 for the Montreal-Quebec Road; $131,000 for the Three Rivers-Grand'Mere Road; $22,000 for the Edward VII. Boulevard; $11,000 to repair the Sherbrooke-Derby line, and $4,000 for the Chambly Road. Seven hundred thousand dollars will be used for the improvement of roads in different municipalities.

The Quebec Streams Commission, of which Mr. O. O. Lefebvre is chief engineer, are inviting tenders for the construction of a storage dam at Lake Brule, ten miles from Beaupre, P.Q. The shceme consists of three dams, a wooden crib dam filled with stone, and two small earth dams. The length of the wooden dam at the crest is to be 225 feet, and the pressure face is to be at an incline of 45 degrees. The dam will rest on solid rock. The structure will give additional water-power to the hydro-electric plant of the Laurentian Power Company.

Contractors Awarded Damages

The acting chief justice has rendered judgment at St John's, Que., in the case of Quinlan & Robertson, Ltd., vs. the cities of St. John's and Iberville. The company claimed $70,945.95 damages for non-fulfilment of a contract they received for the construction of a new bridge over the Richelieu River. The contract had been annulled owing to the irregularity of the cities concerned in not having the project sanctioned by plebiscite. In the circumstances the court held the cities were liable in damages towards the contractors, as the municipalities had neglected to make procedure regular before awarding the contract to plaintiffs. Damages were assessed at $24,297, with interest and costs.

The Dominion Shipbuilding Company's Plant

Considerable progress is being made on the plant of the Dominion Shipbuilding Company at the foot of Spadina Avenue. An interesting feature of the construction is that part of the site is being made up by one of the Harbor Commission's large suction dredges, while construction on a complete section of the site is in progress. The main building will be 485 feet long by 220 feet wide. The cut shows a portion of the east end of the plant, i.e., the furnaces and slabs. Toward the west the concrete piers and foundations are being laid for the machine, blacksmith, pipe and electric shops. The steel for the other shops will be fabricated in a short time. The contracts on hand call for twelve ships; two are about ready now.

One corner of the Dominion Ship Building Company's premises on the Spadina-Bathurst lake front.

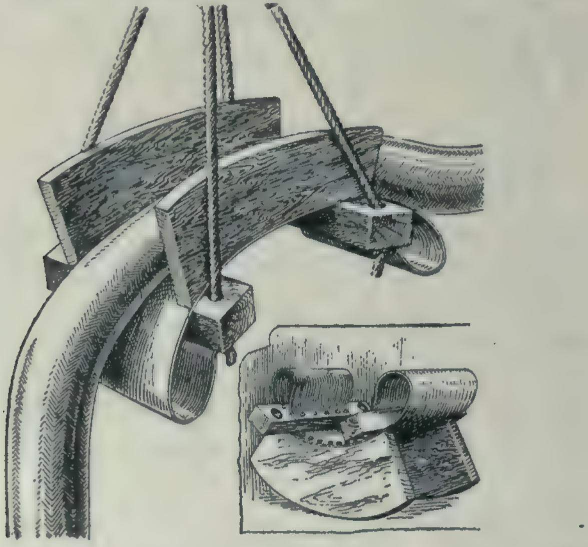
The offices of the Quebec Bridge Board of Engineers have been removed to Ottawa. It will be several months before the work of the Board is completed. Lieut.-Col. C. N. Monsarrat, the chairman of the Board, has been appointed consulting engineer to the Federal Railways Department.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Saddle Supports Hose in Crusher Plant

Everyone has seen a hose tied up with string where its weight drags on a spud coupled to a horizontal pipe at some distance from the floor. Sometimes more pains are taken, as in a stone crushing plant where the writer rigged up the counterweighted saddle shown in the sketch. It was easily made of four pieces of wood, a strip of galvanized sheet iron, a 4-part sling of sash cord and small scrap casting for counterweight. The curve was made somewhat flatter than the curve the hose took in filling with water, to prevent kinking. Several lengths of hose broke before the saddle was put in, after which, of course, the trouble ceased. —L. V. Lauther, in News-Record.



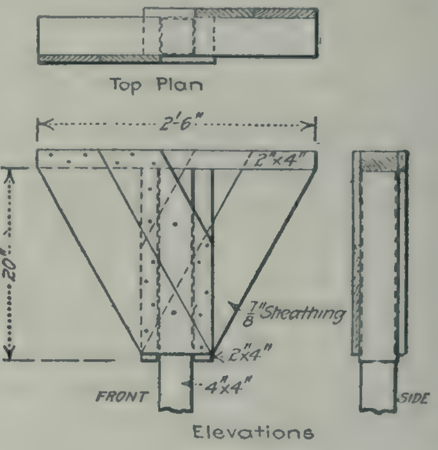
Automatic Device for Regulating the Mixing of Concrete

In order to decrease the liability for incorrect time of mixing concrete an automatic recording device has been invented. The device is located in a box near the large gear of the mixer, with which is is connected by means of a short horizontal shaft carrying a worm gear. The shaft is rotated by means of another gear connected to the large gear wheel. The device is equipped with a bell and recording indicator. When the mixing of the batch is completed the bell rings, thus saving the time of the operator, who otherwise has to remember when the batch was placed in the mixer, in addition to watching the engine, raising or lowering the skip without striking careless workmen, supply the proper amount of water for the mixture, and finally operate the bucket in placing the concrete.

The batchmeter machine not only lessens the work of the operator, thus guarding against poorly-mixed ingredients, but also shows the engineer or inspector that the materials have been brought together properly. The bell seems to assist in speeding up the work of the whole organization; the men in front of the mixer speed up to receive the next batch; also the men behind the mixer are awakened to the fact that their material should be in the skip in the next few seconds to prevent delay.

Shores with Detachable Heads Easy to Store and Ship

The detachable head for form shores shown in the sketch makes it easy to store and ship the shores because of the space saved. One of the heads is slipped over a 4 x 4-inch post and nailed to it with double-headed nails, which can be quickly pulled. This makes as rigid a construction as the ordinary shore, while when the forms are taken down the posts can be compactly piled in one place and the heads in another.—J. T. Sullivan, in News-Record.



Setting Column Forms

Considerable time and expense is often involved in the proper aligning of column forms, especially in the cases where odd geometrical shapes are used. A very good method is to build a small form out of 2 in. x 4 in. stock, of the proper profile, and place these small forms as a base for the column. The carpenter can readily line up the small boxes and, after the concrete has set, can use the base as a template for placing the longer and more cumbersome form. All that is necessary is to place the column form over the template, plumb it up, and brace it. A further advantage in having the short section pre-cast is found in levelling the top of the forms. By leaving the forms a little short one can drive wedges underneath the form and have an adjustment of two or three inches.

The Barrett Company are distributing a little booklet entitled, "Nox-Aer-Leek," which is described as a tough, elastic, adhesive cement for preventing infiltration of air in brick boiler settings. The booklet describes the various conditions under which this cement has proven advantageous and explains its method of application.

Montreal vs. Cook Construction Co.

Arbitration between the city of Montreal and the Cook Construction Company in reference to the enlargement of the aqueduct is now proceeding. The arbitrators are Messrs. W. F. Tye, J. M. Fairbairn, and Aime Geoffrien. The city cancelled their contract with the Cook Construction Company, with the work partially finished. The company are claiming damages for delay, etc., while the city are making a counter-claim. Many witnesses have been called, including several Montreal engineers. The case is expected to last for a considerable period.

Major W. T. Wilson, of the Montreal Light, Heat and Power Company, has presented to the Canadian Society of Civil Engineers a paper knife made out of steel from guns captured from the Germans at Passchendaele. The paper knife, dagger shape, was made at the front, and is ornamented at the handle with a lady's head, beautifully drawn on the steel.

The president and secretary of the Canadian Society of Civil Engineers have been appointed to meet the president and secretary of the Mining Institute to discuss any questions of mutual interest, which may arise, with a view to concerted action.

New Members C.S.C.E.

The following have been elected members and associate members of the Canadian Society of Civil Engineers:—

Members—Messrs. Frederick John Bell, Toronto; president and general manager of the Canada Wire & Cable Co., vice-president of the St. Catharines Steel and Metal Co., manager for Mr. E. A. Wallberg, C.E., Montreal, and advisor to the Laurentian Power Co.; Geo. L. Guy, Winnipeg, in private practise as an electrical engineer, and engineer of the Public Utilities Commission of Manitoba; Benjamin F. C. Haanel, Ottawa, chief engineer, Fuels and Fuel Testing, Mines Department, Branch of Mines, Ottawa; Charles Johnson, Oakville, Ont.; engineer of the Toronto and York Radial Railway; Harold Rindal, Vancouver, engineer of the B. C. district, C. P. R., in charge of all engineering.

Associate Members—Messrs. Walter C. Campbell, Toronto, partner in Messrs. Campbell and Lattimore, contractors; Walter C. Gillis, Ottawa, assistant and chief draftsman to O. S. Finnie, Department of the Interior; John C. Meade, Regina, in 1912, assistant engineer, roads and municipal work, city of Regina, and in July, 1917, discharged as Lieut., having served six months in France with Canadian Engineers; Raoul de M. Prevost, Montreal, first assistant engineer on the staff of the Geodetic surveys department, city of Montreal; Frederick G. Smith, Ottawa, assistant structural engineer, Department of Public Works, Ottawa; Frank W. Townsend, Regina, engineer for Imperial Oil Company in charge of a refinery; William Wotherspon, Calgary, engineer, Department of Interior, Irrigation branch, Calgary.

Transferred from Associate Member to Member—Messrs. William J. Dick, Ottawa, mining engineer, Commission of Conservation, Ottawa; Edmund L. Miles, Calgary, inspector for Department of Interior, Irrigation Branch, Calgary; Needham E. Waddell, Kansas City, Missouri, member of the firm of Waddell and Son, of Kansas City and New York, in charge of Kansas City office, specializing in bridge work.

Transferred from Student to Associate Member—Mr. John Erskine, Hamilton, Ont., Captain in infantry, and formerly engaged on the Bloor Street Viaduct, Toronto, and in charge of hydraulic dredging, Ottawa.

Mainly Constructional

East and West—From Coast to Coast

Permits to the value of $16,435 were issued in Chatham, Ont., during the month of April.

The Interurban Engineering Company, Ltd., has been incorporated, with a capital of $35,000, head office n Toronto.

The Carter-Halls-Aldinger Company, of Winnipeg, has been awarded the contract for the relining of the Rogers Pass tunnel with concrete for the C.P.R.

A theatre is to be built in Regina this summer for the Pantages vaudeville circuit, at a cost of about $100,000. A. J. Rowley, of Regina, is the architect for the building.

Two hundred bricklayers went on strike in Toronto on May 1. Their demand was for a wage of 70c and weekly pay. Some of the employers granted the increase and their men continued at work.

The estimates of the British Columbia Department of Public Works include an item of $1,427,040 for maintenance and repairs to roads, but no provision has been made for new construction work.

James & Smith, Ltd., is the name of a company recently incorporated, with a capital of $40,000, head office in Toronto. Among the objects set forth in its charter is to carry on a building and general contracting business.

Appropriations have been passed by the Toronto City Council for additions to the Perth Avenue and Queen Alexandra schools. Each addition will be in the form of a separate building, on a site adjoining the main school.

Work is being started in connection with the sawmill of the Timberland Lumber Company on the south side of the Fraser River, just across from New Westminster. It is hoped to have the mill in operation by December.

The Minister of Publc Works has announced that work on the breakwaters in connection with the harbor work at Toronto will not be continued during the war. The reclamation work at Ashbridge's Bay, however, is to be completed.

The committee appointed by the Brantford Board of Trade to organize a company to build houses suitable for mechanics and other working men with a view to selling them on the installment plan has for its president Thomas Hendry and as secretary P. T. Knowles. The committee will hold weekly sessions.

London's building permits for April number 114, and are valued at $85,260, which compares with 140 permits, valued at $84,290 taken out in the same month in 1917. There has been a total of 190, at a value of $148,585, issued up to April 30 this year, as against 235, valued at $163,330, during the corresponding period in 1917.

The operating profits of the National Brick Company of Laprarie, Ltd., for the year ended February 28 totalled $22,957, after writing off depreciation, etc., against $22,714 in the previous year. Mr. Ayer, the president, stated that it would be necessary for the bondholders and shareholders to meet before the fall to consider the question of paying interest on the bonds.

The Canadian Northern Railway, now under government ownership, has begun work at Leaside, Toronto, on a roundhouse and on locomotive and car repair shops. A big water tank is already up. The new buildings are located immediately north of the C.P.R. yards and northeast of Leaside station, where a large tract of land for this purpose was secured some years ago. Other works will soon follow, including freight sidings, terminals, and despatchers' headquarters. The Canadian Northern is likely to withdraw from the Union Station and to operate from the new North Toronto Station.

A deputation from Prince Edward and Hastings Counties recently interviewed Hon. F. G. Macdiarmid, Minister of Public Works for Ontario, to request government aid for the erection of a bridge on the line between the two counties. There is at present a bridge owned by a private company, but application is being made to double the toll, and the counties want another outlet.

The Master Masons' Section of the Toronto Builders' Exchange held a very enjoyable social evening on April 18th at 6.45, at the Hotel St. Charles. Mr. Geo. Stocker, president, occupied the chair. A program of songs and readings was followed by a helpful discussion of labor, and other problems relative to the building industry. Several applications for membership were received.

The Toronto Harbor Commission has made a start on their program of work for this season. Operations will be largely confined to reclaiming land and preparing it for sites for new industries. Two 24-inch dredge pumps are now operating, one at the foot of Bathurst Street and the other in the Cherry Street ship channel. Two smaller pumps are working in the slips of the Dominion Shipbuilding Company.

The annual meeting of the Master Carpenters' Section of the Toronto Builders' Exchange was held on April 18th. Officers were elected as follows:—President, W. Clark, Jr.; first vice-president, T. Painter, Jr.; second vice-president, C. B. Jackson; treasurer, J. Brown; representative to Board of Directors, T. Painter. It was decided to increase the scale 5 cents per hour, the maximum not to exceed 60 cents. This section will hold a luncheon on May 2nd.

Apportionment of the cost of the bridge to be constructed by the Toronto-Hamilton Highway Commission over Mimico Creek has recently been made by the Ontario Railway and Municipal Board, as follows: City of Toronto, 45.6 per cent.; balance to be distributed between York County, Etobicoke, New Toronto, and Mimico in the respective proportions of 57.12, 17.14, 10.21, 15.53. It has not yet been decided whether the new bridge will be of steel or concrete. The cost has been roughly estimated at $25,000.

It is expected that the new bridge which has been in course of construction at the foot of Cherry Street, Toronto, since last November will be completed by the first of July. This structure has been erected by the Toronto Harbor Commission in connection with their reclamation work. It has a 120-foot span, with a Strauss bascule lift 66 ft. wide, and is designed to carry street railway, vehicular, and pedestrian traffic. The cost of the bridge will be about $150,000. It is at the main entrance to the eastern harbor terminals.

Quite a number of dwellings are being built in Toronto—practically all of them of the better class, including houses valued at from $10,000 to $15,000. Large construction undertakings are not very numerous, but there are reports regarding some big jobs planned for this season. One of these is the big Eaton warehouse to be erected on Bayside Park, at a cost of some two and a half millions. It is also said that work will start soon on the new Eaton store, whch, according to the proposals made last year, will cost about eleven million dollars.

A bill to incorporate the Canadian Niagara Bridge Company has been brought up before the Railway Committee of the Commons. The object of this company is to build a new international bridge over the Niagara River from some convenient point between Chippawa and Fort Erie on the Canadian side to the opposite side of the river in the State of New York. No objection was raised to the plans of the company, but the committee stipulated that the boulevard of the Niagara Falls Park Commission must not be interfered with except with the consent of the commissioners; and, failing this, plans will be subject to the approval of the Dominion Railway Board. The committee also decided that provision must be made for general as well as for railway traffic, which is the primary purpose of the bridge. Baron Shaughnessy is interested in the scheme; also President A. H. Smith, of the New York Central Railway. The borrowing powers of the company are limited to eight million dollars. It is said the bridge will cost seven millions. It must be started within two and finished within five years.

Personals

Lieut. Percy Booth, of the C.F.C., commanded by Col. White, has been promoted to captain. He went overseas in 1916 as a lieutenant in the 242nd Forestry Battalion. Previous to enlistment he was on the staff of Ross & Macdonald, architects, having his B. Arch. degree, McGill.

Lieut. E. V. Deverall, of Toronto, has been awarded the Military Cross. Lieut. Deverall graduated from the Faculty of Applied Science and Engineering, University of Toronto, in 1915, and previous to enlistment was on the staff of the Dominion Bridge Company. He was previously with the 10th Royal Grenadiers, bu recenly was granted his commission in the Royal Engineers. Last October he was reported wounded.

Lieut. C. F. Szammers, a 1911 graduate of the Faculty of Applied Science, University of Toronto, is now O.C. of the Canadian Corps Tramways, Section 1, which is a composite unit of the Pioneer Company and the Construction Corps, B.E.F. After graduating, Lieut. Szammers followed his profession with Sherwood & Sherwood, Toronto, but enlisted as a corporal with the Second Canadian Pioneers, being shortly promoted to sergeant and later to lieutenant. He has been serving in France for some time, and is now engaged in building light railways to the front lines.

Lieut. Alexander McKenzie West, of the Canadian Engineers, who last December won the Military Cross and was mentioned in Sir Douglas Haig's despatches on January 1, was awarded this decoration "for constructing a bridge under severe fire, enabling the troops to open an attack." Lieut. West is a 1908 graduate of the Faculty of Applied Science and Engineering of the University of Toronto, and his home town is Hespeler, Ont. At the time of his enlistment, however, he was municipal engineer of North Vancouver. While serving with a field company of the Canadian Engineers on the west front, in April, 1917, he was reported wounded in action. He is now attached to the chief engineer's staff at the corps headquarters.

A farewell dinner and presentation to M. V. Sauer, B.A. Sc., chief designing engineer on the Greater Winnipeg Water District scheme, brought together a large and representative assembly of the members of the staff on April 11, at the Fort Garry Hotel. Mr. Sauer has been connected with the scheme from the beginning and as Mr. W. G. Chace's lieutenant and right-hand man has proven his ability and resource in every branch of the complex work entrusted to him. He is now leaving Winnipeg, having accepted a position in the hydraulic department of the Hydro-Electric Power Commission of Ontario. Mr. Sauer carries with him an evidence of the appreciation of his fellow-workers in the shape of a gold watch and chain and an illuminated address presented by Mr. R. D. Waugh, commissioner of the Greater Winnipeg Water District, who occupied the chair on this occasion. Others who spoke in congratulatory terms of Mr. Sauers' work were Messrs. W. H. Carter, president of Carter-Halls-Aldinger, Ltd.; C. B. Kelly, of Thomas Kelly & Sons; R. D. Waugh, Jr., and C. P. Kelpin. Mr. Sauer was formerly with the Ontario Power Company, Toronto.

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Canadian Congress Advanced Good Roads Cause

THE Canadian Good Roads Association held a very successful convention in Hamilton last week, and, considering the conditions under which we are living to-day, it is evidence of the general interest in good roads and the fixed conviction that they are wartime necessities that the attendance was so good and the discussions so practical and animated.

Of course, the association met primarily to exchange ideas on the best methods to adopt in building permanent roads, but much of the work of such an organization must be of an educational nature, and it is hoped that the publicity given to the congress proceedings will go a long way toward acquainting the general public with the possibilities of good roads and rouse them to organize so that their demands may receive attention.

The congress was fortunate in having among the delegates men of the widest experience, from both Canada and the United States—the type that will admit that they have, at times, made mistakes. Indeed, the whole attitude of these men was to make a clean "breast" of everything, so that road engineers and superintendents should not again fall into the same errors. This attitude created a most healthy atmosphere throughout the proceedings, and it is certain that the whole big question of good roads stands to benefit very materially from the congress proceedings.

The one word that, before all others, must have become engraved on the memory of every delegate was "drainage," and second in importance comes "foundation." Speaking of the United States roads, Mr. MacDonald did not hesitate to admit that the greater percentage of their so-called permanent roads were unable to carry modern motor traffic. To use his own words: "We've been buying experience. Now we have to begin and build our roads all over again."

Canada, just on the threshold of an era of road-building activity, should be grateful for Mr. McDonald's tip, and, if wise, will profit by it. As far as it is humanly possible let us build for permanence. Where that is not practicable let us bear in mind the warning so frequently given by the various speakers, that maintenance is next best to permanence; indeed, that there is no such thing as permanence in roadways. For the present we can, at least, "maintain" our roads—let no false arguments of economy interfere.

Importance of Attention to Detail

STRICT attention to detail is a very important item for the consideration of the contractor. The success of any contract not only depends on satisfactory labor, plant and material, but upon careful supervision of each detail in the construction, in order to save time and eliminate cost as far as possible.

Perhaps too much attention cannot be given at present to supervision. The bulk of the labor now is done by inexperienced workmen, who perhaps are not concerned to any great extent with the necessity of strict economy in arranging and placing materials. It is often difficult to explain to the men how work should be done, especially in the placing of forms, etc., for concrete structures. Much time and labor may be saved by a preliminary study of the method of placing the forms on one section of the structure so as not to interfere with the work in another.

On large jobs many firms have lately constructed small models of the form work beforehand and in many instances considerable time and money has been saved by careful study of this model to determine what part of the structure should be partially or fully completed before another section is started. It is much easier to get a foreman to understand what is required by using a model than by taking him into the office and using plans which are more or less difficult to follow and can show graphically but one plane at a time.

In most work the stopping of a steam shovel, concrete mixer, etc., for ten minutes may seem negligible, but it is not only the time lost by the machine itself, but, because of the close relation between one part of the work and another, when this ten minutes loss has been traced through the different operations its time value will have increased to an alarming extent and with it the ultimate cost of the work.

Considerable increase in the cost of construction, as evidenced by the final estimate, will be found due to breaking some part of the working equipment. It is true that breaks sometimes occur where least expected and without any previous indication of weakness. On the other hand, a pulley which has been cracked for weeks is still in use; a rope badly worn is still doing duty; that shovel handle has been split for some time. But in these days of high prices it is essential that each tool be used as long as it will give service without using up extra time by reason of its inefficiency. However, there is no telling when the break will occur, and if an extra tool has not been placed in expectancy, it means a hold up and a hold up costs money.

On all work, a competent man should make frequent trips for inspection purposes, special attention being paid to the condition of the plant equipment as well as to note how a delay in one part of the work will cause delays in other operations. Careful study beforehand of where materials can be obtained with the least possible delay should be made. It is a good idea to draw up a schedule of the operations and to adhere to this as nearly as possible.

Smoothness and regularity in the carrying on of the work not only decrease the cost materially, but it reacts on the labor, in such a manner as to make every man satisfied with his part of the project and by good will and co-operation the maximum degree of work is obtained with the minimum amount of friction and dissatisfaction.

Time is the Essence of the Contract

IN a brief letter of comment from Mr. J. P. Anglin, reproduced elsewhere in this issue, he makes the statement that unless the scheme for the breaking of new land in the West by contractors gets under way immediately there is little chance of influencing the 1919 production. It surely would be a grave error, in these days of grain shortage, to have such an excellent proposition fall through without giving it a fair trial. There can scarcely be any room for doubt that large areas of land could be cropped in this way that will otherwise be idle. The only uncertainty is as to the cost, and is this a thing to be considered if our men in Europe are short of food? Besides, it is likely to prove most profitable. If the people of Canada see the government deliberately neglect any promising opportunity of increasing food production will they be likely to heed the food controller when he counsels abstention? If conditions are half as bad as they are officially reported to be, this contractors' scheme, and any other that promises assistance, should be given instant and liberal consideration.

McGill Science Results

The results of examinations in faculties of Arts and Applied Science at McGill University have been made public. In applied science Mr. Emil Edwin Weibel, who graduated as a mechanical engineer, won the British Asociation medal and the Crosby Steam Gauge and Valve Company's prize for summer essay, while he took honors in hydraulics and laboratory and hydraulics machines, machine design, and thermo-dynamics.

Passed for B.Sc. Degree

Civil engineering—Henri B. Pelletier, Montreal. Unranked—Arthur A. Brown, Ottawa.

Electrical engineering (in order of merit)—Joseph M. Conroy, Britannia Bay, Ont.; Joseph A. Dionne, Montreal; William McL. Moore, Sydney, N.S.; William R. Way, Montreal; Daniel McL. Sutherland, New Glasgow, N.S.; Leo J. Jordan, Lindsay, Ont.; Thomas J. Fox, New York; Frederick L. Cann, Peterboro, Ont. Unranked—Ira W. Beverly, Rossland, B.C.; William H. Gerrie, Kenora, Ont.; James F. Patterson, Montreal; Roy A. Weagant, New York.

Mechanical engineering (in order of merit)—Emil E. Weibel, Montreal; Charles S. Parke, Hamilton; Hugh A. Crombie, Toronto.

Mining engineering (in order of merit)—Harold M. Roscoe, Centreville, N.S.; Edward A. Livingstone, Washington, D.C. Unranked—William Weir, Notre Dame de Grace, P.Q.

Chemical engineering (in order of merit)—Herman R. Dorken, Westmount, P.Q.; Clifford Greaves, Barbados, B.W.I. Unranked—George G. Ulmer, jr., Montreal.

Model Housing Scheme for Vancouver

Comparatively few homes have been erected in Vancouver since the outbreak of the war, this being largely due to the fact that the city had been overbuilt in the preceding three years, owing to the good times and the steady increase in population then marked up. The return of prosperity last year to nearly every line of business, along with the rapid development of the shipbuilding industry, has brought to Vancouver some thousands of new citizens, and as a consequence the housing problem has become acute. Desirable dwellings are admittedly very scarce, the result being seen in a rapid advance in rental values, in which apartment house owners have shared to the full.

Under these circumstances the public will welcome with particular interest the news that the Taylor Engineering Co., Ltd., of which A. J. T. Taylor is managing director, has in hand a scheme to establish in Point Grey municipality a model home community of 225 dwellings on a 53 acre block of C. P. R. land west of Granville Street, between Thirty-seventh and Forty-first avenue, and east of the Kerrisdale gardens of that company. The surveying of the property will soon be completed, when roadbuilding and other preliminary work will be proceeded with. The location of the block chosen is ideal from a residential point of view; there is a fine outlook both north and south, and two or three street car lines within reasonable distance.

It is proposed to erect a class of moderate priced buildings which will vary greatly in design and combine all the modern improvements and time-saving aids that are incorporated in the model community towns now becoming quite numerous in the East. Electric light and heat for cooking purposes, also steam heat, will be furnished to all houses from central systems, and garage accommodation will also be provided. It is expected the residents will comprise persons whose incomes range from $125 to $200 a month. Such citizens may purchase homes outright, by cash agreement, or if preferred make monthly payments on a rental basis.

The company's plans include the construction of hard surface roadways and walks and the laying of sewers and watermains to connect up with the municipal systems.

Road Construction and Maintenance

ROAD IMPROVEMENT IN MANITOBA—1917

By Mr. Archibald McGillivray*

THE general progress of constructing roads under "The Good Roads Act" of the Province of Manitoba has been very satisfactory during the past year, considering the conditions which obtain owing to the continuance of the great world war. The great shortage of labor, with the consequent rise in wages, materials and plant, has resulted in the curtailment of many projected schemes for road improvement, the incompletion of others and the increase in the cost of all works undertaken. The absolute necessity of good roads in the development of the country's great resource—agriculture—has become very apparent to the people as a whole. While the actual mileage of roads being built is small in comparison with what would be built if conditions were normal, still, the sentiment for good roads has increased tremendously, until at this time the solution of the road problem is classed as one of the ranking questions of the day.

The first task of our country is to help win the war. Canada's great part in this is one of production, and the question of good roads is inseparably entwined with production.

The second task of our country is to prepare for after-war conditions, and good roads will certainly be an important factor in placing Canada in such a position as to enable her to successfully combat her economic rivals. Such is the view that the officials of many of our municipalities are taking on this question. Among those with whom the Provincial Good Roads Board co-operated last year were the municipalities of Portage la Prairie, Sifton and Wallace, whose schemes of road improvement, totalling an estimated expenditure of $459,000, were taken up under the Act, all preliminary arrangements made and money by-laws submitted to the ratepayers of the respective municipalities. In each case the action of the council was approved and the by-law assented to. It is not the intention to push these works to completion with all dispatch, but to undertake the most essential first, such as renewal of old worn-out bridges and culverts with permanent structures, the grading of the poorest stretches of road where improvements are necessary, and leave the balance of the scheme until such time as conditions may become more settled, labor more plentiful and the money markets for flotation of loans more opportune. The idea of these councils is to be in readiness when more normal conditions return.

A most important work was undertaken last year in starting the construction of the Portage Highway through the municipality of St. Francois Xavier, a distance of 27½ miles. This highway is the most important through route, running east and west through the province, and it is the intention of the Department to improve this highway under the government assistance provided in "The Good Roads Act," viz.—66 2/3 per cent. of the cost, as rapidly as possible. The road has been paved already as far west as the Village of Headingly, about 9 miles from the city of Winnipeg, and the above 27½ miles are a continuation from the end of the pavement. The estimated cost of the improvement contemplated is $165,000, the standards being sand-clay and gravel surface. Ten miles of the heaviest grading was completed last year and the balance of it is under contract for completion at once. Thirty-five miles of this highway from the western boundary of the province easterly have been completed during the past three years with gravel surface and permanent structures. The grading of sixteen additional miles connecting with this stretch are now under contract for this year, and it is hoped that by gradually working from year to year that the whole line will soon be improved across the province.

Several new features in concrete bridge construction, for the western portion of the Dominion at least, were introduced last year. Principal in this connection was an 86½ foot span reinforced concrete structure over the Valley River in the municipality of Grandview. The design is a bowstring truss, being nothing more than an open spandrel arch with elastic abutments—the unique feature being that the floor is suspended from the arch ribs instead of being superimposed as ordinarily in this type of bridge. The thrust from the arch ribs is taken by a horizontal tie at floor level and provision is made for horizontal displacement due to temperature expansion by a system of roller bearings. The necessity for such a design is owing to the river being used for log drives, making a provision for maximum clearance and water way essential, a through structure had to be erected. Heretofore steel most likely would have been employed for such a situation, but the high level to which the price of this material has reached since the war, led to the investigation of concrete, which proved more economical.

Good roads in Wallace Municipality, Man.

The expenditures on roads and bridges constructed during the year 1917, under the Good Roads Act was $466,946. Of this amount the government of the

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* Highway Commissioner.

86½" concrete span over Valley River, Municipality of Grandview, Man.

province contributed $220,996 in cash to the municipalities, besides the services of the Good Roads Engineering staff.

The number of miles of roads constructed during 1917 is as follows:—

	Miles.
Earth Roads	174.07
Gravel Roads	90.74
Total constructed	264.81

There have been constructed to the end of 1917 under "The Good Roads Act":—

	Miles.
Earth Roads	365.82
Gravel Roads	191.69
Pavement (Asphalt and Concrete) ...	23.25
Total	580.76

During the year 1917 plans were prepared by the Bridge Engineers of this Department for 131 bridges, and contracts let for 101; 20 were left uncompleted from the previous year, making a total of 121 upon which action was taken. Of these 85 were completed, 10 had been started, but not completed during the year, and 26 have not been started. Of the 85 bridges completed, 49 are reinforced concrete; 11 steel on masonry abutments and 25 of timber construction.

In the building of bridges, as in no other part of road improvement, is it possible to introduce to the same extent the element of permanency of design and construction. The use of structural steel, therefore, so extensively employed in the construction of bridges having become almost prohibitive owing to the great demand of this material for war and ship-building purposes has been much decreased in the province during the past two or three years, and reinforced concrete as a substitute therefor is being fully developed. When the importance of these structures as an integral part of the highway is considered, the reliance which must necessarily be placed in their capacity to accommodate traffic of every description over them, the safeguarding of life and property of the travelling public, every means should be employed to erect structures in our highways that will be commensurate in design and stability with the function they are called upon to perform. That the municipal council have a keen appreciation of this is evidenced by the fact that of the 230 bridges built in the province during the past three years, under "The Good Roads Act," 146 were of concrete, 31 of steel, 4 timber on concrete or masonry abutments and 49 timber throughout.

This province assists the municipalities in the construction of all bridges, by furnishing the councils with plans and specifications and engineering inspection, and by contributions in cash of fifty per cent. of the cost of all structures of a permanent character costing $2,000 and over, and thirty-three and one-third per cent. of the cost of timber structures costing $500 or over.

ALBERTA'S ROAD PROGRAM

By Mr. L. C. Charlesworth*

THE Public Highways Act, passed at the recent session of the Alberta Legislature, is a long step in the direction of a system of good roads in the province.

It provides the machinery whereby work may be carried out in a systematic manner on a basis of cooperation between the provincial government and the local authorities. The act is short and simple, and, while actual operation under it may, and doubtless will, show some flaws on omissions, as is inevitable in the case of such legislation, the belief is that the general principles involved are right, and that it is only in questions of detail that changes will have to be made.

A short synopsis of the provisions, as prepared by the clerk of the Executive Council, is as follows:

All highways are divided into three classes: (a) Main highways; (b) district highways; (c) local highways. Main highways are those of prime importance by reason of being trunk channels of communication between the main cities and towns of the province or with main travelled roads situated outside and adjoining the province. District highways are those of less general but of considerable local importance. Local highways are all such highways as are not classified as main or district highways.

The minister shall denote upon a map the exact route of main and district highways throughout each area through which they are intended to pass, after consultation as to main highways with every municipal authority concerned, and as to district highways after agreement made with and ratified by by-law of every municipal authority through whose area the highways are intended to run.

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* Deputy Minister Public Works.

After the establishment by order-in-council of any main or district highway, the fact of its establishment shall be published in The Alberta Gazette, and no change shall be made in the route except by order-in-council.

Seventy-five per cent. of the cost of construction of main highways and 25 per cent. of that of district highways shall be borne by the Department of Public Works, and the balance and the cost of local highways shall be borne by the local authorities. The cost of maintenance of main highways shall be borne by the department, of district and local highways by the local authorities. The minister is given power to direct that a portion of the cost and maintenance of a district highway shall be borne by the local authority of any area through which the highway does not in fact pass, such partial cost to be in proportion to the benefit the area receives.

Each municipal authority must pay its proportion of the cost of any main or district highway upon demand after construction.

In case of the failure of a municipal authority to maintain any district highway within its area the minister may give notice, and if the highway is not repaired within fifteen days the minister may authorize the road to be put into proper state of repair, pay the cost of same, and recover the amount from the defaulting municipal authority.

Provision is made whereby the minister may build or rebuild any bridge upon any highway where the cost of same has been provided for by a specific vote of the Legislature, and in case of flood or other accident the minister may repair any bridge, paying the cost thereof.

All money due the department from any municipal authority shall form a special lien against the municipal taxes. All work shall be let by tender, except in cases where, from its nature, it can be otherwise executed more expeditiously and economically.

All mechanics, laborers, and other persons engaged in highway work shall be paid fair and reasonable wages.

The minister is given power to make rules and regulations for the traffic of vehicles on any highway in the province.

The act does not come into force in its totality until the 1st of January, 1919, so that during the coming season time will be provided for careful classification of the highways.

So far as work during the coming season is concerned, the chief endeavor will be in the direction of maintaining our present roads, and not a great deal of new construction is likely to be undertaken.

Increasing the capacity of water mains by cleaning them is a conservation measure that some waterworks superintendents have overlooked. A recent report from a southern United States city states that an increase in carrying capacity of 97-2/3 per cent. was effected by cleaning 6,111 feet of 10-inch water main. The line had been in service 17 years and had carried a very hard water from artesian wells. The incrustation removed by the cleaning machine averaged 7½ lbs. per foot of pipe.

QUEBEC PROVINCE

By Mr. B. Michaud*

THE Province of Quebec will spend about $1,500,000 helping the municipalities to build their roads in macadam or gravel and to maintain the roads already built. In view of putting into effect our different road acts and, in particular, the road act passed in 1917, regarding the maintenance of macadam or gravelled roads, the Minister of Roads has divided the province into three districts, each of which is under the direction of an engineer, with his staff. The three engineers, in charge of the districts, are, of course, under the control of the chief engineer and assistant. This is merely a new development, and a normal one, of the various measures adopted since 1912, towards the carrying out of our extensive road policy. We expect it to be most effective from the point of view of engineering and supervision, and from an economical point of view. To put in a nutshell, the past and present trend of our road policy, I may say that, having built five great trunk roads, and having under way the construction of a sixth one, which will be the last one, we will continue to help municipalities to improve their roads, and will favor those uniting together to build themselves trunk roads.

Amongst the features of the road work to be done directly by the department next summer I may mention the laying out of an asphaltic carpet coat of 50 or 60 miles over the Montreal-Quebec road, the surfacing of over three miles of that part of the King Edward Road connecting with the dyke built by the federal government at Laprairie. The completion of several gaps in different municipalities, where miles of macadam or gravelled road have been built since 1912, will be closely attended to by us. The contract let last year for the laying out of nearly 10 miles of asphaltic concrete, on an additional part of the Montreal-Quebec Road, in the vicinity of the City of Quebec, will probably be entirely carried out.

Contractors vs. Greater Production

Montreal, May 10, 1918.

Editor Contract Record:

Referring to the editorial in your issue of May 8, I am afraid that whoever reported the talk which I gave to the Montreal Rotary Club did not clearly grasp the figures, in so far as the acreage is concerned.

The number of acres which we had proposed to break this year was 540,000, but owing to the lateness of the season this program was cut in half. The project as outlined calls for the breaking of 60 additional groups, or 540,000 acres, in 1919. From this you can see that the crop in 1919 would be taken from 270,000 acres, and in 1920 from about three times that acreage.

These figures will make the larger figures in dollars, which you quoted in your isue of May 8, seem more reasonable.

I should say, while I am writing, that unless the project gets started before your next issue comes out it will not be possible to undertake any great amount of breaking this year, so that the main work of the project would have to be put over until the early spring of 1919.

Yours very truly,

J. P. Anglin.

A number of architects have sent a letter to the Montreal Catholic School Commissioner protesting against a proposal by one of the Commissioners to form a board of construction.

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*Deputy Minister of Roads.

Canadian Good Roads Congress

Association Meets in Fifth Annual Convention at the Royal Connaught Hotel, Hamilton—Good Attendance, Splendid Papers and Some Live Discussions — Next Year Probably in Quebec

THE Fifth Annual Congress and Exhibition of the Canadian Good Roads Association was held in the Royal Connaught Hotel, Hamilton, on Tuesday, Wednesday, Thursday, and Friday of last week. The morning of the first day was given over to registration and the afternoon to the address of the president, Capt. J. A. Duchastel de Montrouge, and to addresses of welcome and appreciation. Mayor Booker of Hamilton extended the freedom of the city to the delegates. Mr. S. L. Squire spoke for the Canadian Good Roads Association, Mr. Russell T. Kelley for the Hamilton Board of Trade, Mr. L. B. Howland for the Canadian Automobile Association, and Mr. M. J. Overall for the Hamilton Automobile Club. Addresses were also given by Mr. W. A. McLean, Deputy Minister of Highways for the Province of Ontario; Mr. B. Michaud, Deputy Minister of Roads for the Province of Quebec, and Mr. James MacDonald, ex-State Highway Commissioner of Connecticut.

Wednesday Morning Session

Mr. B. Michaud, Deputy Minister of Highways for the Province of Quebec, occupied the chair on Wednesday morning. Mr. Bertram, of the Toronto-Hamilton Highway Commission, introduced the subject of "Who Should Pay for the Roads?" in a brief paper. In the discussion which followed Mr. W. A. McLean spoke in a hopeful strain of the possibilities of financing our roads schemes. At the moment there is no great shortage of money, but the men are not available, due to their employment on what appears to be more essential work. Mr. McLean emphasized the importance of maintenance as the most valuable part of any highway organization. A cheaply-constructed road properly maintained is better than a very expensive road badly maintained. The type of road and the cost of the work must depend on the traffic requirements. In Ontario the government had already taken over a very considerable portion of the main artery connecting Toronto and Montreal, and this would be extended. There will be no difficulty paying for these roads when it is appreciated that the towns and cities that profit by them most should pay the greatest portion of the original cost and the maintenance. When traffic over the country roads was mostly horse-drawn and the city dweller very rarely drove beyond the outskirts, he had little interest in the state of these roads. With the rapid and tremendous development in automobile traffic, however, this is all changed, and the inhabitants of the cities and towns are quite as keenly alive to the necessity of good country roads as are the farmers themselves. With this change of heart there should be no difficulty in getting the cities to pay their fair share of the expenses.

Roads Will Be Paid for Because They Are Wanted

Mr. McLean pointed out that, with the increase in capacity of transportation vehicles, and also the far more rapid rate at which they move, good roads are very much more essential than they were a few years ago. The whole thing is largely a matter of the attitude of mind of the citizens. In the past we did not want good roads particularly. To-day we want them, and, wanting them, can and will pay for them willingly. To think of 250,000 miles of highways that cover Canada and the cost of improving them is apt to discourage one, but all this work cannot be done at once, and all the money will not be required for many years to come. The main thing is to start right and keep going. Ontario has started out, having as a foundation as equitable a financial scheme as can be found in the world.

The chairman called upon Mr. Anderson to say a word regarding the attitude of the people along the Toronto-Hamilton Highway towards the payment for that road. Mr. Anderson stated that there was now expressed very general satisfaction with the proportion the cities and towns were bearing. Naturally, the people felt that the government should pay for most of these main arteries, but the farmers in the main were satisfied that their investment was yielding them good results.

Mr. J. H. McDonald, ex-State Highway Commissioner of Connecticut, deprecated the idea of good roads being looked upon as an expense. It is much nearer the fact to call them an investment. No large appropriations were needed at any one time. It was a matter of getting started, profiting by experience, and working steadily toward the goal to be attained. Many of the roads built up to the present time had cost more than they should, but the experience gained by a few should be used to the advantage of the many. The greatest care should be taken to study construction, maintenance, traffic conditions, and general results of the main highways of the continent and profit by this experience in building the roads of the future.

Mr. W. Findlay, of Ottawa, described the success of the city of Ottawa in raising money towards the construction of good roads leading into their city. It did not appeal to him that Toronto and Hamilton had been called upon to pay particularly large sums towards the Toronto-Hamilton Highway. Toronto, he understood, had paid $250,000 and Hamilton $50,000, whereas Ottawa, with a population one-fifth that of Toronto, had contributed $180,000 to their Prescott Road scheme. As soon as the war is over, he anticipated, there would be no trouble inaugurating the county road systems; that the city of Ottawa would willingly pay its share, and that the suburban roads will be constructed as provided for by the act. He, too, urged that all available data should be studied by good roads engineers, so that the mistakes of the past, in Canada and the United States, should not be repeated.

Afternoon Session

Mr. W. A. McLean, Deputy Minister of Highways for the Province of Ontario, presided at the afternoon session. The first paper was presented by Col. W. D.

Sohier, chairman of the Massachusetts Highway Commission. Col. Sohier referred to the objection usually offered to the construction of the roadways at the present time—that it interferes with farm and other essential operations. His experience showed that this was not the case. As a matter of fact, in his state the road work and farm work were found to dovetail into one another to such an extent that the farmers profited. Col. Sohier paid a splendid tribute to the roads of France and their value in stemming the tide of the German invasion. Most of these roads are macadam, from 24 ft. wide up, and paid for by the state, at a cost of about $12,500 per mile. On a recent trip he had endeavored to locate in France an area of any appreciable size where there was not a state-built road, and he came to the conclusion there was not a square mile of territory in which such a road did not exist. As typical of the way France has spent money on roads, he stated that in 1914, if the war had not broken out, the appropriation for this purpose would have been in the neighborhood of $60,000,000. England at the present time is spending in the neighborhood of $5,000,000 a year to maintain her general good roads, and it was Col. Sohier's opinion that just now, more than at any other period, on account of their military value, our roads ought to be maintained.

Capt. J. A. Duchastel de Montrouge,
Retiring president.

Mr. S. L. Squire,
President-elect.

G. A. McNamee,
Re-elected Secretary-treasurer.

The Need for Foresight in Road-Building

Col. Sohier stated that the trouble with most road-builders is that they do not see far enough ahead. He instanced a case where an average traffic of 37 vehicles per day before the road was repaired immediately jumped to 1,200 per day under improved conditions. Then, too, the roadways are being used to a very much greater extent for freight traffic. For example, the Goodyear Tire and Rubber Company have an 800-mile route trip, over which they send motor trucks. There are many other instances at the present moment in the United States where time is a much bigger element than cost in the delivery of freight, and the motor truck rapid delivery is a feature of transportation.

For the new kind of traffic—that is, heavy truck traffic—stronger roads than we have at present will be necessary. The first essential of such roads is good drainage, on top of which there must be a solid foundation.

The speaker quoted some figures of tests recently taken by the Packard Company, showing the tractive effort required to drive a truck over roads of various types. Comparative figures for concrete, macadam, gravel, and dust roads were as 30:50:80:99—that is, more than three times the power is required to draw a ton over a dirt road than over a concrete road. Another test quoted was wheer a team of 1,600-pound horses had been utilized to draw a 3-ton load. Comparative figures in this case were: Concrete, 83; topeka mix, 207; macadam, 245; gravel, 513 — a ratio from the most favorable to the least favorable of about 1:7. Cases were also instanced where, in the United States, farmers hauled two and three times as large loads as formerly and made more trips per day. In conclusion, the speaker again emphasized the necessity of drainage and strong foundations. It is impossible to build a road too well, if it is to withstand hard service, and, in addition to this, we shall never want the roads as much as now.

Road Work Behind the Lines

Col. McKendrick spoke in a most interesting strain of his experience covering some two and half years close behind the battle line in France, where he had under his supervision 12,000 men and some 750 miles of road. The French roads were originally in excellent condition, but, of course, the enemy had paid particular attention to them, and they were now gutted with shell-holes anywhere from 5 to 15 feet deep, many of these holes being filled with water. The strain, too, could be appreciated from the fact that heavy guns with caterpillar tractors which operated them, weigh up to 17 tons. For permanent repairs stones were the most frequently used material. Often he used from 900 to 4,000 tons of stone a day, and on the whole system he maintained some 56 rollers, 300 motor lorries, and 300 wagons. Col. McKendrick's experience in road-building in France taught him that the best results were obtained by placing large stones on their flats rather than on their edges, which was formerly considered best practice. The usual roadway has a 9-in. stone base. This, well crowned and well rolled, was found to bear up almost any traffic. These roads cost much less than the former type and also were more easily maintained. However, the type of stone available in many localities wore away very readily. In the period during which Col. McKendrick was in charge of this section of roads the stone surface had to be replaced at least twelve times. The best size stone to carry heavy lorries he found to be 4, 5 or 6 in.; smaller sizes had not sufficient bearing surface. The speaker stated that the Frenchmen were the finest and most economic roads repairers in the world. A Frenchman could make a barrow of stone go as far as another man would make a cartload go. It was the Frenchmen's genius for road-building and maintenance that had saved Verdun.

Build Wider Highways

"Wider Highways" was the subject of a stirring address by Mr. W. Annis, of Whitby. The standard road in Ontario is 66 ft., which does not allow of the separation of telephone and power pole lines from decorative and shade trees. As a result, when a pole line is run along a roadway the trees are frequently mutilated and their value, both from an aesthetic and utilitarian viewpoint, diminished. Mr. Annis advocated the increase in the width of the roadway to 86 ft., so that the trees could be placed outside the pole lines, where they would have sufficient room to develop uniformly.

In this connection Mr. Annis stated that he had taken the matter up with Mr. McLean, Deputy Minister of Highways for Ontario, and Mr. McLean had assured him of the sympathy of the department with the idea, and that the main roads of the province would in all probability be constructed on the basis of the greater width—that the road from Toronto to Kingston was planned according to these specifications.

Another suggestion made by Mr. Annis was to the effect that main highway arteries should be constructed as a sort of memorial to our soldiers who have fought and died in France, in the interests of world civilization.

In the discussion which followed Mr. Annis' address, the chairman strongly supported the suggestion that highways be built in commemoration of the brave deeds of Canadians at the front, and that for this very reason they should be built thoroughly and permanently; they should, in effect, be victory highways, both in name and fact. Mr. McLean corroborated Mr. Annis' statement that the Ontario Government had practically arranged for the extension of the width of the main highway system to 86 ft.

English and American Practice in the Construction of Tar Surfaces and Pavements

Mr. Arthur H. Blanchard, consulting highway engineer, New York City, gave an illustrated talk on modern practice in the construction of tar surfaces and pavements. Mr. Blanchard emphasized the importance of keeping accurate records, both in the way of figures on costs, material, etc., and by having excellent photographs taken showing the various construction operations.

A war dinner was held on the evening of Wednesday, the 8th, at 7.30 o'clock, which was attended by some hundred delegates.

Thursday Morning Session

On Thursday morning Mr. J. H. MacDonald, ex-State Highway Commissioner for Connecticut, read his paper, entitled, "The Most Important Consideration Entering Into Road Construction—Drainage."

A lively discussion was aroused by this paper on drainage—or perhaps it would be better to say that Mr. MacDonald was bombarded with questions by delegates, who were anxious to learn more from his wide experience. Mr. MacDonald had spoken of the Telford base in his paper so highly that some of the members had gained the impression that he considered this type of base justified under all conditions. In the discussion he made it plain that this was not the case. While strongly in favor of as permanent a foundation as it was possible to get, engineers were quite justified in using the material nearest to hand, as this reduced the cost very materially. Messrs. Michaud, Fraser, Drinkwater, and others gave the results of their experience. In answer to another question, Mr. MacDonald stated that he did not install or believe in the use of blind drains. Frequently he had dug pockets in the fields adjoining the roadways where there was no possible outlet for drainage. The use of sink holes in the same connection was also advocated by one of the delegates.

The question of the relative value of concrete and clay tile for drainage purposes was also the subject of a live discussion arising out of Mr. MacDonald's paper. One of the delegates stoutly argued that clay tile is not porous, and that its value as a drainage conduit lay chiefly in that quality. Another delegate raised the question as to whether it mattered seriously whether tile used for drainage was porous or not. It was finally concluded that the porosity of both clay and concrete tile is very largely regulated by the locality from which the materials are taken and the method of manufacture. It was pointed out by Mr. Drinkwater, and also by Mr. MacDonald, that clay tile, under certain conditions, is porous, and concrete, under certain conditions, is not porous.

In answer to another question, Mr. MacDonald stated that he always used plank under ordinary field tile, so as to keep them in alignment. He was of the opinion that if the tile were laid directly on the earth there was greater danger of joints opening and of the drain getting out of alignment, and, as a result, becoming blocked. One of the delegates gave it as his experience that these boards would rot in spots, and so cause the unevenness they were intended to prevent.

Mr. MacDonald closed the discussion by reiterating once again the necessity for considering the first essential of good roads as proper drainage, and the second essential a solid foundation. The United States, in spite of the tremendous sums of money already spent on roadways, had now to begin all over again, as only a very small percentage of their so-called permanent highways would stand up under present-day motor traffic.

In the afternoon the question box was opened and an interesting discussion followed on the best methods of keeping roadways cleared of snow during the winter. A number of delegates had had experience with rollers, but were not favorable to this method. It was stated that there is now a satisfactory Fairbanks-Morse machine on the market that has been tried out in the Montreal district, with excellent results. This is believed to represent the most satisfactory equipment to date. The president, Mr. Duchastel, described the experience he had had with this machine during the past winter. His experiments showed that in open districts and rural roads snow could be kept cleared from sidewalks and roadways at one-third of the cost of former methods. He had opened up with this machine anywhere from ten to twelve miles of sidewalks in a day. As the snow situation in the Montreal district is probably as bad as that experienced in almost any city on the continent, it will be seen that Mr. Duchastel's experience was of great value to the delegates present.

Invitations to Quebec and St. Catharines

Mr. Michaud, Deputy Minister of Roads for the Province of Quebec, here rose to express for the delegates from his province their appreciation of the cordial reception of the city of Hamilton to them during the convention, and extended a hearty invitation to the association to meet next year in the city of Quebec. This invitation waas given in the name of the province he represented.

A similar invitation had been received from the city of St. Catharines, and a motion was made at this point that letters of appreciation be sent in reply to both invitations, with the assurance that the matter would receive the most careful consideration of the executive.

What the Motorist Can Do to Help

Mr. L. B. Howland, president of the Canadian Automobile Association, gave a stirring address on "What the Motorist Can Do to Help the Road Movement and Relieve the Transportation Congestion." The first essential was that all automobile drivers should join the motor league, since collective influence was bound to be so much greater than individual. Mr. Howland advocated very careful consideration of the location of main arteries, and he believed that a minimum of trunk lines, with liberal tributaries branching out north and south, would best meet the present conditions. Immediate steps should be taken to establish proper laws governing the roads, both as to automobile, horse, and pedestrian traaffic Everything should carry lights. At the present time considerable difficulty is experienced in the matter of headlights. The Ontario law has not been enforced, largely on account of the difficulty of obtaining proper equipment. Mr. Howland considered it the function of the manufacturer to overcome this difficulty.

The speaker was strongly of the opinion that all vehicles should carry lights and that speeds should be regulated depending upon the load weight. He urged motorists not to forget the road etiquette of earlier motoring days, when it was customary for every motorist to offer his assistance to other travellers in distress.

Mr. Howland also touched upon the difficulty of operating motors in winter, particularly in the country districts. This difficulty was increased by the fact that the gauge of sleighs is narrower than the motor gauge. He advocated the widening of the sleighs to the standard of wagons and automobiles.

The tremendous amount of tonnage formerly carried by the railways, but now operated by motor truck over the highways, was instanced by Mr. Howland as evidence of the probable future on Canadian roads. Last year, in the United States, 1,200,000,000 tons of freight had been carried by motor trucks, at a cost of 18c per ton-mile, as compared with 28c per ton-mile when horses had been used for this purpose. During the present year this would be increased to three times the amount of last year. This has had a very satisfactory effect in relieving the traffic congestion. One city instanced by the speaker had overcome the congestion in the centre of the city by having the freight trains met at the outskirts by motor lorries and having distribution made from these points, rather than from one central point.

A very practical suggestion was made by Mr. Howland along the lines of the establishment of "return load bureaus." Mr. Howland exemplified this with reference to the Toronto-Hamilton Highway. Supposing a certain firm had delivered a truck load of their product in Hamilton from Toronto, the truck would ordinarily return empty. However, if there were a central bureau in Hamilton where information would be kept on file as to the location of freight ready for transportation to Toronto, this truck could be used to carry a load back. With a similar central bureau in Toronto, trucks starting their trip from Hamilton would carry return loads in the same way. Such a scheme would practically cut in half the cost of transportation, would double the usefulness of the truck, and save valuable time in the same proportion

Concrete Roads

An interesting paper on concrete roads by Mr. A. Lalonde, C.E., assistant engineer, city of Outremont, closed the session for the afternoon. His paper is reproduced in full elsewhere in this issue.

Election of Officers

The election of officers for the coming year resulted as follows: Honorary president, Capt. Duchastel de Montrogue, Outremont, P.Q.; president, S. L. Squire, municipal adviser to Ontario Government, Toronto; secretary-treasurer, George A. McNamee, Montreal; advisory board: A. H. Dandurand, Montreal; B. Michaud, Deputy Minister of Roads for the Province of Quebec; W. A. McLean, Deputy Minister of Highways for the Province of Ontario; Capt. O. Hezzelwood, Toronto; directors: A. F. MacCallum, Ottawa; P. E. Mercier, Montreal; A. L. Caron, Montreal; Dr. E. M. Desaulniers, M.L.A., St. Lambert, P.Q.; R. S. Henderson, president Manitoba Good Roads Association, Winnipeg; J. A. Sanderson, Oxford Station, Ont.; C. R. Wheelock, president Ontario Good Roads Association, Orangeville; W. G. Yorston, Assistant Highway Commissioner for the Province of Nova Scotia; W. Findlay, Ottawa; R. T. Kelley, Hamilton; L. B. Howland, president Canadian Automobile Association.

A Book for the Amateur Gardener

Garden Steps—by Ernest Cobb; Silver, Burdett & Co., Boston, publishers; a manual for the amateur in vegetable gardening. These are days when practically every householder, whatever his downtown business may be, is interested in the utilization of some small plot of ground for increasing food production. Experience has shown, however, that there is a very considerable percentage of wasted energy, due to lack of experience or knowldge of the rudiments of vegetable gardening. In this connection we are pleased to have located an up-to-date little book which covers, briefly and practically, most of the operations with which amateur gardeners are concerned. As the author states in the preface, he has endeavored to gather into small space "the necessary information regarding the culture of each important vegetable for the home garden and arrange it so that the amateur may take each necessary step in its proper turn, guided by clear, explicit directions."

Concrete Roads—Cost and Maintenance

By Mr. A. Lalonde*

When a community decides to construct a road, the officials must find out first the amount of money available to pay for the initial cost; secondly, the amount of money available to pay for maintenance charges; the next step will be to decide on the type of road which will better serve their purpose and traffic. Concrete road will certainly be amongst the different types they will be called upon to choose from. In making this choice they have to bear in mind the essentials of the ideal road, which may be detailed as follows:—

It should be (a) durable, (b) sanitary, (c) noiseless.

It should not be (d) slippery.

It should be (e) thoroughly adapted to motor traffic. (f) The initial cost, as well as the maintenance charges, should be low. Low maintenance naturally means easy repairs.

The demand throughout Canada today is for a long mileage of low cost roads, but there is quite a difference between this statement and the belief so strongly entrenched in our different provinces that every time we ought to choose the cheapest road. It is an established fact that maintenance cost is much lower on hard surface roads than on any other types. The gross annual cost per square yard, which includes interest on initial cost, plus amortization, plus annual repairs, on different pavements, are, according to E. W. Sternes, Chief Engineer of Highways, Borough of Manhattan, New York, as follows:—

Nature of the Road	Annual Cost per sq. yd. in cents
Concrete	7.8
Asphaltic Concrete on 6 in. base	11.0
Sheet Asphalt on 6 in. concrete base	11.25
Brick on 6 in. concrete base	14.00
Bituminous Macadam	15.70
Asphalt Block	16.90
Water-bound Macadam	17.75
Wood blocks	20.40
Granite Blocks	21.00

Concrete roads will fulfill nearly all the above requirements of the ideal road. Though there are no very old concrete pavements in existence built under the present practice, the present condition of those that have stood quite a few years of service would be enough to satisfy anyone who may doubt their durability. They offer very little resistance to traffic; they produce practically no dust and may be easily cleaned; they are not too slippery; they are thoroughly adapted to motor traffic, if well maintained. They can be constructed at a reasonable cost. As a matter of fact, I think they are the cheapest of all hard surface roads. It may also be noted that when considerably worn down by traffic, they may be used as a very sound base for asphaltic concrete, sheet asphalt, brick or wood block pavement. They can be maintained at very small cost.

On the other hand, they are quite noisy, but this disadvantage should not be taken into account in the case of rural roads.

There is no method, to my knowledge, to prevent wear in the vicinity of joints. Cracks may appear even in places where joints are well constructed. Regarding ease of repair, this objection is a valid one, but sooner or later an easy method of making a first class patch will be found. Until then it would not be advisable to construct concrete pavements in a rapidly growing community, if numerous street cuts are to be made in the surface.

There have been many pavements constructed with inferior materials which accounts for a good deal of the defective concrete pavements in Canada, as well as in the United States. Only concrete materials of first class quality for paving purposes should be used. The possible sources of supply of these materials are not quite developed and data regarding some are most generally not available. The investigations and reports made under the supervision of L. Reinecke, of the Geological Survey, will be of great help to road builders in this country.

Any successful road requires a good deal of care as to details, and this is more true of concrete pavements than of any other. Cement is a wonderful material, but it has to be used properly. After a specification is adopted and the contract made, its terms and requirements should be followed rigidly. Some of these requirements may seem exaggerated, especially when shown through this light by some paving contractors, who, I should say, do not understand even their own interest. Often in this case the engineers' or inspectors' views are overruled and the result is inferior construction. The inspectors should be familiar with the specifications used, and must look upon them as their reference library. The specification of the Canadian Society of Civil Engineering for cement is commonly used.

Care should be taken that cement is stored in a dry shed where water will not leak through the roof or the walls. The bottom sacks should not be left in the shanty until the whole job is nearing completion.

Sand should be carefully chosen and examined on account of being one of the controlling factors in the wearing properties of the surface. It should be free from clay, loam, and vegetable matter. Careful instructions should be given to laborers shovelling same into wheelbarrows that they do not shovel part of the soil on which the sand is deposited. Sand, the grains of which have natural coatings of limonite or other foreign matter, make a very friable mortar. As far as possible, only washed sand ought to be used.

The coarse aggregate being called upon to take the wear and tear of the road, should be hard, tough and durable. Its hardness should be at least equal to that of the mortar used. It is also to be remembered that it has to sustain the shattering effects of the steel shod traffic. So all soft stones, slates, shales, limestones, etc., should be rejected. It should, of course, be clear of lumps of clay, pieces of wood, scales from uncleaned wheelbarrows. The presence of such matters will sooner or later produce local pitting and an increased wear on the surface. Long flat stones should be picked up, first because they produce scaling, and also they are very liable to come out sooner or later, and leave a bad hole.

It is not a good policy to use the crusher run stone, as well as pit run gravel. These materials will not give to the concrete pavement the required uniformity of texture and hardness of surface. The dust which they contain in quite a large quantity will retard the hardening of cement. These materials should be screened and separated in fine and coarse aggregates, even if it adds a certain amount to the cost of the work.

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*Assistant Engineer, City of Outremont.

When building a two course pavement, the bottom course aggregates may be softer than in the one course construction, but on the other hand, the wearing or top course must be richer in cement than the one course. The maximum size of aggregate should be smaller than the one course and also harder. Permit me here to quote Messrs. Agg and McCulloch, in their "Investigation on Concrete Roadways," for the Iowa State Commission (page 88):—

> "The life of a concrete pavement depends to a large degree on the correctness and uniformity in the proportioning of the materials. Emphasis should be laid on the fact that the present methods of field proportioning are exceedingly crude. The development of the bituminous pavement surface has been characterized by the adoption of accurate methods of proportioning and grading the materials. Concrete as a surfacing material will never be used at its highest efficiency until the proportions are specified by weight, and these proportions accurately maintained as the materials are placed in the mixer."

General Construction

I would like now to say a few words regarding the general construction. Heavy stress should be laid on the making of subgrade and drainage. Unequal settlements should be avoided. No concrete should be laid over fills which are not thoroughly compacted, or have not yet attained their ultimate settlement, which takes place at the end of about one year. A flat subgrade gives more concrete in the centre, where it is most needed, though one that is shaped to conform with the finished surface takes less concrete and gives better drainage. The subgrade should be rolled and reshaped until it has the specified shape and uniform firmness. This will not only prevent waste of concrete but will also facilitate the movement of the pavement due to contraction and expansion, and therefore prevent the formation of cracks. It is a well noted fact that a rough and uneven subgrade renders the transverse joints about useless.

The system of drainage should be carefully studied and planned. It should not only take care of surface and underground waters, but provision should also be made for temporary drainage, so as to prevent the washing of green concrete by surface water. Such occurrences necessitate often the tearing up and removing of the entire pavement slab. The problem is to keep the subgrade dry by using different resources or materials available. Were it not possible to do so, the design of the pavement for such a length as found necessary should be changed. In a poorly drained subgrade there is a tendency for the edges to dry out quicker than the centre, with a consequent settlement and production of longitudinal cracks in the pavement surface, especially when the cold weather sets in or goes out of the ground. Nearly all engineers today are of the opinion that the unsightly cracks that one may notice in many concrete pavements are due, to a very great extent, to poor drainage.

Finishing

General practice seems to favor the wooden float. If handled by a skilled workman, it will give a satisfactory surface, sufficiently rough for all ordinary grades. The thinnest possible skinned coat of cement should be brought to the surface, so as not to cause scaling. Over-floating not only costs more money to the contractor, but does not give as good a surface.

It must be borne in mind that after concrete is deposited and floating done, the pavement is not finished. Good care should be taken that green concrete is not exposed to the hot rays of the sun. Canvas should be kept over the green concrete for about 24 hours, after which it can be sprinkled. No empty cement sacks should be allowed on the green concrete. Dirt can be used at the end of forty-eight hours and should be kept wet for ten days. These precautions, if they are not overlooked, will prevent shrinkage cracks and conserve water which will be needed for chemical combination of cement. Curing by ponding is also a very excellent method. The inspectors should see that all the dirt is completely removed and the surface well cleaned before the road is opened to traffic. As to the time of opening such roads to traffic, I would quote the following extract from the "National Conference on Concrete Roads for 1916" (page 215):—

> "The length of time necessary to keep the pavement closed to traffic will depend entirely upon weather conditions. During warm weather the pavement should be kept closed to traffic for at least fourteen days and preferably for three weeks. When the conditions are such that the temperature of concrete is less than 50 degs. F. when placed, hardening takes place very slowly. As is well known, the hardening of concrete is a chemical action requiring heat. The hardening will take place in direct proportion to the amount of heat present, and takes place very slowly at a temperature of 35 degs. F. or below.
>
> "When a concrete pavement has been laid in the late fall, it is sometimes difficult to determine when it will be safe to throw the road open to traffic. In rare cases it may be necessary, owing to peculiar local conditions, to open the road or street to traffic before it is absolutely safe to do so. Under such conditions if about 3 inches of straw is placed on the pavement and this covered with several inches of earth, the surface of the pavement will be protected sufficiently against abrasion to allow the opening of the road sooner than could be safely done without such protection. This cover will, however, not minimize the danger of damage to the pavement by heavy loads, which will tend to crack pavement that has not developed its full strength. Concrete roads have been utterly ruined by opening to traffic too soon. Few people realize how slowly concrete hardens under unfavorable conditions, which will undoubtedly prevail on some jobs before the work is finished. All those in charge of concrete pavement work should have the necessity of adhering to the foregoing cold weather precautions strongly impressed upon them."

Distance Between Joints

The recommended practice for transverse joints is that joints should be placed across the pavement perpendicular to the centre line, about 50 feet apart. There seems to be a tendency to lengthen the distance between joints, and, moreover, to eliminate same entirely. Many engineers today advocate the placing of transverse joints only at the end of one day's work. The different kind of soils over which the pavement is laid should not be lost sight of. A good practice when metal protection plates are used is to finish the pavement at least six inches on each side of the joint with the steel trowel. Though considerable difference of opinion exists as to the use of such protection plates it seems that the present practice has much tendency to do away with them.

Many of the unsightly longitudinal cracks will be done away with in concrete roads if precautions have been taken to ensure a thorough sub-drainage and a uniform subgrade. Longitudinal cracks are the worst enemy of concrete roads, it has not yet been proved by any plain concrete roads that they can be eliminated altogether, but with the refinements of the present practice in constructing such roads, they will be reduced to a minimum. The use of reinforcement will eliminate to quite an extent the formation of longitudinal cracks, or at least will render them less objectionable. Mesh reinforcement is much easier to place than bar reinforcement. Reinforcing depends on the condition of soils and loads, and it is a matter that certainly should be left to each engineer to determine on the spot the needs of the situation, after having well weighed all the circumstances. Some engineers are of the belief that the use of reinforcing will ensure stability to the road, scatter shrinkage cracks and eliminate joints.

Regarding the thin bituminous wearing surface for concrete pavements, the results obtained to date do not economically justify its use just at present. Maintenance of concrete pavements will be greatly simplified as soon as a satisfactory method of coating their surface has been devised.

Maintenance

Now, Gentlemen, after the road is completed and opened to traffic, it has to be maintained, and this is a point that should be strongly brought up and clearly demonstrated to the officials of all communities which are in for good roads. An efficient, systematic and intelligent system of maintenance should be devised and enforced. I do not need to show here the full economic value of such a system, and no municipality, or province, or country will ever realize the benefit and the merits of a good road unless it is properly maintained. While the cost of systematic maintenance of concrete pavements is small, if we neglect to maintain same the cost may be very high and the taxpayer would have not received the greatest value for his money.

When engineers make the statement that the concrete roads represent minimum outlay for maintenance cost, highway officials should not derive from these words that when a concrete road is finished no more care or attention whatever should be given to it. This would be a very grave mistake. It is inherent to human nature that everything will wear away in the course of time, and it is so with all pavements, though they may be called permanent.

I will now read you a few lines from the Ninth Annual Report of the Board of County Road Commissioners of Wayne County (page 32):—

> "Recognizing that durability and low cost of maintenance, as mentioned in preceding reports, largely determine the success of any type of road, our preference, based on our past seven years' experience, continues to be for concrete construction. We believe in constant and systematic maintenance of all roads under our jurisdiction. As in past years, our gravel and macadam mileage continues to absorb the bulk of our maintenance moneys and energies. We have repaired and oiled all gravel roads, and in addition thereto dragged them systematically in both the spring and fall.
>
> "The wisdom of building of concrete, in our judgment, stands out conspicuously when maintenance cost involved in keeping all other types of roads under our jurisdiction in usable condition is compared with the actual cost of maintaining concrete. Yet, even the best concrete road will require some maintenance, consisting principally of cleaning out and refilling expansion joints, the repair of pockets which occasionally appear on the surface as a result of some foreign material such as clay getting into the concrete, some fragment of inferior pebble or stone, or defects in workmanship. Usually no maintenance is required on our concrete roads the first year of their life, but if we find that any is necessary we do it promptly and thoroughly.
>
> "Our concrete roads possess the special feature of presenting a surface that wears but slightly and uniformly; a surface that does not give way in any one spot and withstands traffic over its entire surface. This is made possible by careful selection of materials, careful methods of proportioning and mixing, and care in finishing and curing, resulting in a concrete having a uniform texture, which is a big factor in eliminating maintenance costs. We have over 125 miles of concrete road in Wayne County, some of it in its seventh year of service; all of it in good condition, and we have never taken up and replaced a 25-foot section since we have been building and developing this type of road, which, we think, speaks volumes for our low annual maintenance costs."

Pavement—Hot Mix Method of Bituminous Construction, Using Asphaltic Binder

By Mr. E. Drinkwater*

I PROPOSE to deal with this matter in a general way, that will give the salient features of this subject matter, and entirely omit and leave the technical matters to the authorities of standard specifications now so easily procurable, and which can be obtained from any reliable manufacturer of paving materials, and who are exhibitors in this hall.

First, I propose to give you a synopsis of the various methods employed by the writer during a period of from 20 to 30 years.

I have been more or less the whole of my life actively connected with pavement construction, and previous to 1910 had always had to make use of that which was locally procurable and economically purchased, and had always adopted the mixed method for bituminous construction. That is to say, the fine or coarse stone aggregate was always coated with the bituminous binder before being placed in its pavement position.

In the early days of my work I may say that we used gas tar, procured directly from the gas works, at a very nominal cost. We coated the stone in dry, warm weather, without any heating. The tar was heated in what we called tar boilers, some of which were of a very large size and portable. In cold or damp weather we dried out and warmed the stone on plate floors, heated by steam or hot air flues, such as we also used in brick-making. After coating, the stone was stored in the various sizes, separate, and under cover until required for use on the work, and when laid was designated as tar macadam. It was laid in courses of 3 in., 2 in., and 1 in. stone to a total depth of 6 in. on either old macadam or a well-laid Telford base, and after many years of use these pavements would compare favorably with other more costly types of construction. These results were due, to a large extent, to the excellent quality of coal gas tar that was available.

In 1909 I was called upon to construct pavement by the mixing method to a specification which called for the coating of stone first with hot air and then give a second coat of hot asphaltic cement, and laid into position before the binder cooled off. The mixing was done by hand on the site. When the weather was continuously fine and hot this method gave a very satisfactory pavement, and after nine years' wear may be found in good condition to-day. But when the weather was unfavorable it was impossible to carry on the work satisfactorily, and any work, done under unfavorable conditions as to weather, never proved good, and entailed considerable maintenance expenditure annually, due to the high cost of the sheet asphalt and other such manufactured pavement. We decided to adopt the penetration method. This was in 1911, and I laid a considerable mileage on old macadam and on new, well-laid and drained Telford base. For a time these pavements were seemingly satisfactory and economical to construct. It was not very long, however, that, in accordance with the good, dry weather during construction, so was the quality of the pavement, and those sections that did not have the most favorable conditions began to disintegrate in the fall, and the surface in the hot weather became out of shape.

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It became manifest that the method could not give continuous good service, and the hot mix method was the proper way in which the proper gauging and mixing of materials could be obtained, and by the use of improvised plant I proved to my employers that better results could be obtained by its adoption, as it eliminated the bleeding in hot weather, and was less slippery in cold weather on grades.

Since 1911 I have laid no pavement other than the hot mix type, and according to the requirements used for city pavement, sheet asphalt where grade was flat on concrete base, varying from 5 to 10 inches thick, according to the amount and class of traffic, on the same grade I have used the asphaltic concrete (Topeka mix) on concrete base, which requires 4 per cent. to 5 per cent. less asphaltic cement than sheet asphalt, and, therefore, lower in initial cost.

On grades upward of 5 per cent. it is necessary that larger stone should be employed in the aggregate. This can only be done with the consent, and under the Warren Brothers' patent, covering bithulithic and Warrenite pavement.

These pavements all entail a costly and immobile plant, and considerable area to carry out the work of preparation of paving materials, and I propose to deal with the construction method that may be used to construct a fairly well-proportioned and thoroughly mixed pavement that will carry any class of traffic, and be constructed as continuously as any other type, and regardless of water supply, by machinery of low cost, and mobile, viz., the ordinary concrete mixer with the heating attachment, traction wheel, and distribution arm, that can be obtained from the many manufacturers of contractor's plant. After the base has been prepared in the manner decided upon, and ready to receive the wearing surface, the machine can be placed on the travelled way or pavement area, and the material distributed along the line of work. It is preferable, however, if there is space available on the side of roadway, to place the machine there and protect the base, the construction to be carried out as follows:

Mixing

Stone aggregate to be of a size that will pass a 2½ in. ring and retained by a 1½ in. ring, to be placed in the mixing drum, and the hot blast applied. When the stone is heated to a temperature of approximately 250 degrees Fahrenheit the asphaltic binder, previously heated in a portable heater, to a temperature of not less than 200 and not more than 275 degrees Fahrenheit, is then added to the already heated stone, the quantity to be within the limits of 12 per cent. to 13 per cent. by weight of the total quantity of the stone in the mix.

Laying

When the stone is thoroughly coated, the batch should be emptied as soon as possible and carried by the distribution arm, or any other means convenient to use, to the dumping platform, if macadam base is used; if concrete base, on the base, within spading distance of the laying point, the mixture to be laid either by spade or fork, level, and even to a depth of 3 in., loose. and well packed into position.

Rolling

When slightly cooled off, the rolling by a 12-ton macadam roller follows, care to be taken that the line and camber is maintained. Any hollow spots must be immediately levelled up during the rolling, and the roller kept moving until the paving is thoroughly compacted. When this is done. and before the pavement is cooled, the mix in the machine should be changed.

Surface Coat

And a mixture of three parts of stone, one part of rough sand, heated as the stone, and mixed with 12 per cent to 13 per cent. asphalt cement, heated to the temperature of not less than 225 or over 275 degrees Fahrenheit. and the stone and sand to be thoroughly coated. When the mixing is completed, a surface treatment is given to the already laid and still warm pavement to a depth evenly laid of approximately ½ to ¾ inches in thickness, and as soon as laid the roller started again, to drive this coat into the voids that may exist between the previously laid stone; and here care should be taken to watch that any parts of the surface needing extra material should receive it during the first rolling, when it will manifest itself. When sufficiently rolled, the whole pavement should be then just covered with a coat of warm stone chip of ¼ in. down, and as soon as cooled off the pavement may be used for traffic.

Asphaltic Cement

Any well-known brand that will fulfill the standard specification requirements. Of a penetration of from 60 to 90 at 77 degrees Fahrenheit will be satisfactory material to use for this class of work.

Mixer

A standard mixer of ¾-yard capacity will turn out 800 to 1,000 yards per day, or 200 yards of 16-feet roadway per day, and can be operated either by steam or gasoline power and the heater be provided with crude oil burners. The traction attachment makes it possible to eliminate considerable haulage delay, and the machine can be kept always alongside the work being laid.

In conclusion, I beg to say that I find the asphaltic cement binder a satisfactory material to use, due to the fact that its natural ductility allows ample time for compacting before setting up. It is less subject to variation of temperature than any other material, and climatic changes have no effect. In spring and fall it does not get excessively hard and slippery, and in summer the heat does not have any appreciable effect, and at all times will it carry any load that the foundation will carry. It will give good service, is easy to repair, and is low in maintenance cost.

The offices of the Quebec Streams Commission have been removed to the Provincial Government Building, 59 Notre Dame Street East, Montreal.

Abatement of the Dust Nuisance

By Mr. E. R. Gray[*]

The subject which we are now to discuss, i.e., "The Abatement of the Dust Nuisance," is a matter concerning which much has been written, and in connection with which a considerable amount of valuable experimental work has been performed.

The result of this study has been the establishment of certain well-recognized standard principles in the application of the methods to which I shall refer.

It is not my intention to deal with the subject in a formal way, but merely to outline something of our local experience, in the hope that it may be helpful to some here present.

The dust nuisance may in varying degrees of efficiency be dealt with by the following methods:

1. By removing the dust and loose material on the surface by the use of mechanical methods, such as horse sweepers, tooth scrappers, etc.

2. By the application of a dust layer in the form of (a) water from the ordinary sprinkler; (b) a deliquescent salt, as calcium chloride, applied by hand; (c) a bituminous material, either as an asphaltic petroleum or a tar product.

This being the method which will form the subject of our discussion.

3. By the construction of what is known as a dustless, permanent road surface of some one of the many standard types. This, however, is outside of the scope of this discussion.

The application of any one of the above methods or the combination of parts of each depends upon the condition of the surface and the character of the roadway to be treated.

Horse-sweeping hand-brooming, and the removal of the dust by teams and wagons does much to keep the roads free from the material which blows, after which the road may be further treated if it is so desired.

The second method, that of applying a dust-layer of some kind, is to-day perhaps the most generally adopted for dust abatement and road preservation. As ordinarily applied, however, this method is far from perfect, and we await with interest the discovery of some more effective and some less troublesome cure for the dust nuisance.

We easily see that road oiling has become a very efficient operation for dust prevention, but, while we have tried many methods of varying our work here in Hamilton, I am free to say that as yet it has not developed that perfect state which you might be led to believe. The year before last we were using what is known as a light road oil. We were getting very good results from it, and in many cases were getting a pretty fair cover, and it was with the desire of securing a heavier cover that last year we used a quantity of medium road oil. You know what the season was like—it was cold and wet, and, in fact, we had to give up some of our oiling altogether because of the weather conditions. The oil being somewhat heavier than the oil that had been used in the previous seasons, we had a terrible holler from the people on the streets. We usually put screenings from our quarries on the oil after it has been distributed, and in a measure we do away with that difficulty, but we found it is impracticable to close our streets in order to keep the traffic off them for a sufficient length of time for the hardening of the oil. If we were doing a street at a time, here and there, that might be arranged, but where you are doing miles of streets—and we have many miles of improved macadam roads in the city—it is not a feasible method of handling the situation.

Continued experiment over the past ten years has practically established the fact that the application of some kind of bituminous material to the surface of he road is the most efficacious method known to date. Salts, chiefly calcium chloride, have been used, but so far as I know, these have never gone past the experimental stage or have been applicable only on small sections of road. Calcium chloride is obtained as a by-product in the manufacture of soda, and is distributed dry, by sowing over the road surface or spreading by shovel.

In connection with the use of calcium chloride, it is used in England to quite a large extent, the atmospheric conditions there lending themselves to the use of this particular material to a great deal better advantage than it does in this country. In fact, where it has been used (it was used around Boston) it was necessary, after the application, to water the roads, sprinkling the roads in order to secure sufficient moisture to keep down the dust. The salt, by its faculty of absorbing moisture, dampens the surrounding dust layer, thereby reducing the tendency to blow.

An experiment of this character was carried out by the United States office of good roads, under the direction of Logan Walker Page, in Florida, by the application of 1½ pounds of chloride per square yard of surface. After several weeks of wear the surface was always moist. No costs are given in connection with this method, so that comparison is impossible.

Enquiry as to the present price of calcium chloride in fairly large quantities shows that it is 4 cents a pound, so that for dust preventive purposes on the present market prices it is hardly an economic consideration.

The character of the road and the condition of the road surface are important considerations in deciding upon the particular treatment to be used. It is generally conceded. and results have proved, that as much of the loose material as is economically practicable should be removed from the surface of the road. I have read that, under certain circumstances, some engineers have gone so far as to lightly sprinkle the road before the application of the oil, with the idea of removing the thin film of dust from the stone, which would prevent the proper adherence of the dust layer to the macadam. I would think that was rather a dangerous procedure, unless the road was given sufficient time to dry subsequent to the application of the water. Under such conditions, then, what is going to happen to this dust that lies on the road It is going to be spread over the road again, so it seems to me rather a superfluous procedure

Any repairs necessary, then, to the old macadam should be made, in order to improve the conformation of the road and provide for a free drainage to the gutter.

On country stone roads, where frequently the dust lies inches deep in layers, a horse-sweeper could be used with great benefit, and at very little added expense, to remove this surface material to the side of the road, where could be taken care of by different means, depending upon the environment. I have in mind many country roads where, regardless of the character of the surface of the road and the amount of dust and loose material on the road, the oil cart goes along and sprinkles the sand. It is only a short time before that oil dust is blowing with every vehicle that passes, making the actual dust conditions much more disagreeable than the ordinary dry state of the dust. Oiling performed then would be much more effective, and I am of the opinion that the results would warrant the small additional expense of such cleaning.

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[*] City Engineer, Hamilton.

Having prepared the road surface, the next consideration is the character of the material which is to be used and the method of its application.

Asphaltic petroleums and tar products are the most common materials used for this purpose. Until recently they have been easily obtainable. They lend themselves readily to distribution, and, prior to war prices, were an economic material for this purpose.

The asphalt petroleum is sold commercially as a 40 per cent., 60 per cent., and 80 per cent. asphaltic oil, increasing in specific gravity in the order named. The tar products are sold under trade names which indicate varying degrees of specific gravity, the purchaser purchasing that particular product which is most suitable for his requirements.

Our experience in Hamilton has proved that what is known as a "light road oil" or a "medium road oil" for city work may be used with great effectiveness. In some cities a considerable lighter oil is used than the above referred to "light road oil," but this requires a more frequent application, with a consequent increased cost.

Ordinarily, except under very heavy traffic, one application per season has been found to be sufficient of the 40 per cent. and 60 per cent. asphaltic petroleum. The lighter grades of oil may, however, be applied earlier in the season, and without the necessity of heating, in order to facilitate distribution They are easily absorbed, dry out more quickly, and reduce the dust nuisance during the late spring and early summer months. Light oils are applied, also, in smaller quantities than the heavier oils, as low as .085 gallons per square yard being found sufficient for good results. This is a very low figure; it is the Toronto figure, and it is necessary to go over these roads two or three times a year But they do away with that sticky condition which obtains in the use of heavier oils.

Oils are applied to road surface by several methods, depending upon the character of the road and the amount of oiling to be performed. In small communities it is sometimes distributed from the barrel by use of the ordinary hand sprinkling can. In such cases lighter oils are used and heating is obviated. In a larger way it is applied by gravity from tanks, either through a perforated pipe or specially adapted nozzles for the purpose, the oil being applied either hot or cold, depending upon its specific gravity. Large motor pressure distributors are now frequently used where the amount of work warrants it, this method of distribution being usually known as the penetration method. The material is applied hot, a heating device being used in conjunction with the distributor. I have not the exact mileage of macadam in the city, but we have felt that we would not be justified in the purchase of a large distributing pressure sprinkler, for the reason that with our eight-horse-drawn sprinklers, one in each district, we are able to cover so much more ground and are able to get our work done early in the season, earlier than if we were operating one machine only. We find that when we start oiling that the people are very anxious to get their streets oiled, and it is a problem to know which street to oil first. However, we have had to make a rule that the streets with the greatest amount of traffic will be the streets that will first receive attention, regardless of how many friends a particular man had on the street or how anxious he was to get his street oiled before his neighbor.

Much better results are obtained if the road surface is warm when the oil is applied, as diffusion through and over the surface then readily takes place before the oil congeals. This is especially applicable to the heavier bituminous materials The surface should be free from moisture.

I was going to put it stronger, and say it must be free from moisture. We have, however, got caught out in a rainstorm with a cart full of oil, and let her rip, but if the sun came out and dried things up quickly it was not so bad. But we have had difficulty where the oiling was performed on damp, wet surfaces in getting proper drying and penetrating effect.

Heat is usually necessary in the application of the heavier road oils. In Hamilton, where last year and this year we are using a medium asphaltic road oil, i.e., an asphaltic oil which under certain conditions of test contains an average of 60 per cent. of the original asphaltic petroleum, the oil is first heated in large steel tanks by steam coils to a temperature of from 200 to 250 degrees, and pumped into ordinary oil carts, from which the oil is distributed by gravity on to the street. The method of procedure is carried out as follows: The street is first thoroughly swept by horse-brooms and all the loose material that is practicable is cleaned from the surface of the street and removed. Oil, while hot, is then applied by a gravity sprinkler at the average rate of 1/8 gallon per square yard of road surface. Course rock screenings and stone dust is then distributed by hand over the surface of the oiled road, in order to more quickly absorb the oil and prepare the road to receive traffic. In calculating that figure of 1/8 of a gallon per square yard of road surface we measured the road from curb to curb. The sprinkler does not sprinkle the whole width of the street, but the whole width is effectively oiled, in that a certain amount of the oil runs down the crown and effectively oils the portion next to the curb, so that I feel it is right and fair to consider that the whole road surface is oiled.

Ordinarily the street is not closed to traffic. Better results would be obtained here if the streets were closed from 24 to 36 hours after the oil application, in order to allow a certain amount of absorption and hardening of the oil to take place before traffic is allowed on the street. On busy city streets, however, this is hardly practicable. When we are oiling up one street and down another we would have a large section of the city completely ostracized from the rest of the town except by pedestrian traffic, and this would cause great inconvenience, and we find it does not cause really serious difficulty to let the traffic go right over the street after being oiled.

The amount of oil used depends altogether upon the character of the surface being treated and the extent of the coating desired. It varies from an eight to a quarter of a gallon, and sometimes one-half gallon per square yard.

I might say that last year in Hamilton a very accurate cost was kept in connection with street oiling, as carried out in this city, the detailed statement of which was published in the Canadian Engineer of December 13, 1917.

The average cost, without regard to overhead, such as superintendence, engineering, repairs to plant, depreciation, insurance, etc., was $1.67 per 100 square yards. This is equivalent to $235 per mile of 24-foot roadway, or a little less than 2¼c per lineal foot of frontage. I was surprised when we began to figure up our overhead in connection with our road-oiling proposition; our repairs to our little pump at the yard where we have our tanks, the cost of steaming, for heating, the repairs to our tanks, the depreciation, insurance; we found that it amounted to 31 per cent. of our total cost. I went into that very carefully. I was thunderstruck, but that is what keeping costs tells us, and if any of you have further experience in connection with your cost of road oiling we should be glad to hear something of it.

Ordinarily, unless costs are very carefully analyzed, and a knowledge of conditions obtained, the figures are apt to be misleading rather than instructive. They vary, depending upon the price of labor, material, and the methods adopted, so that real efficiency must be judged on a basis of these considerations. The following base prices were applicable to the above costs:

Teams per hour	.75
Labor per hour	.35
Oil per gallon	.096
Screenings per ton	.85

The screenings were distributed by shovel from a wagon as it went down the street.

The third method of dust prevention—that of improved permanent dustless highways—is beyond the scope of this paper.

Asphalt Pavements for Modern Road Building

By Mr. Charles A. Mullen*

The broad subject assigned to me is far too comprehensive to fall within the scope of a single paper. We will therefore brief those parts which are of historical or general interest, and pass on as quickly as possible to the consideration of the phases of the subject that are of present day interest to the modern road builders of North America.

The sheet asphalt pavement is not a modern invention. This material was used for street covering purposes by the Ancients, and sections of it have been dug up with the other evidences of past civilizations. Having in mind the centuries that have elapsed since its first employment as a street pavement, the surprising thing is that so little progress has been made in its development, and practically none until recent years.

Kinds of Asphalts

The European asphalt pavement is the rock asphalt, it being prepared from native bitumen-impregnated rocks. The natural substance is ground to powder, heated, spread, and then compacted by tamping or very slow rolling. To secure the best results, two or more rock powders from different sources and having different characteristics are combined to produce a better grading of mineral aggregate and a more satisfactory bitumen content. Many very good asphalt pavements have been laid with this material in Europe, and some on this side of the Atlantic.

The American asphalt pavement was first produced by E. J. De Smedt, about 1870, and may be considered as an attempt on his part to imitate, at a less cost in this country, the rock asphalt pavements of Europe. The Europeans still term rock asphalt as natural, and the American product as an artificial asphalt pavement. As has happened in many other cases, the substitute leaves nothing to be desired of the original.

The first asphalt pavement of the American or artificial type to attract wide attention was that laid on Pennsylvania Avenue in the city of Washington, District of Columbia, about 1876. Congress provided that this national thoroughfare should be paved with sheet asphalt from the Capitol building to the White House, that section east of Sixth Street to be rock asphalt and the section west thereof to be artificial asphalt. Previous sections of pavement laid in other cities had been of but small yardage and of an experimental nature.

The modern asphalt pavement consists of a mineral aggregate of specially graded sand and impalpable dust, thoroughly mixed, and bound together with asphalt cement. Roughly speaking, the mineral aggregate is ninety per cent. by weight or seventy-five per cent. by volume, the specific gravity of the bitumen in the asphalt paving cement being but slightly more than that of water. The grit mixtures and the stone-filled sheet asphalts are the same with a small proportion of fine stone chips added, not usually over thirty per cent.

Asphalt Cements

The asphalt paving cement is, of course, a vital matter, since we could not have an asphalt pavement without it. More pavements fail to-day, however, because of the lack of an understanding of the necessary requirements for the mineral aggregate, or carelessness or ignorance in the making of the paving mixture. Our public officials frequently go to great lengths to make sure that the materials furnished are what they should be, and then permit those materials to be spoiled at the asphalt mixing plant.

Many good asphalt cements are on the market to-day. They are manufactured from crudes found in Mexico, California, Trinidad, Bermudez in Venezuela, and elsewhere. All are of so nearly equal value that only the uninformed or specially interested will to-day pay a great difference per square yard for asphalt pavement in which one or the other has been properly used. The per square yard competitive basis under carefully drawn specifications and competent inspection is now universally recognized in wholesome communities.

Asphalt cements need testing no matter from what crude materials they are made nor by whom. Some public officials do not seem to think so; but could they know how well they are spotted by the supply houses, and how carefully this frame of mind is cultivated for them, they would very soon change these views. Doubtful material, or material that has been condemned by some careful official who does have his deliveries tested, is always shipped to the other man.

The consistency or penetration of the asphalt paving cement is the first point to which we look. In a material that is pure, and with a mineral aggregate that is properly graded, it is customary to use the following classes of material for the different conditions of traffic in this climate:

Heavy Traffic	45 to 55 penetration.
Medium Traffic	55 to 65 penetration.
Light Traffic	65 to 75 penetration.

Unless otherwise specified, all penetration tests are made with a number two standard needle acting for five seconds under a load of one hundred grains at seventy-seven degrees Fahrenheit.

The ductility and other tests are of great importance in determining the quality of the asphalt cement, but they are more particularly the concern of the asphalt chemist, and must receive close attention at the laboratory. The field engineer should be in close touch with the chemist and know the general characteristics of the asphalt cement he is using, but we will pass these points for the present to discuss others that are of more immediate importance to the greater number of us.

Fluxed or Cut-back Asphalts

Fluxed or cut-back asphalts are so little used to-day that they no longer present a serious problem; at least, not in Canada. It is much easier to manufacture asphalt paving mixtures from cement that is delivered to the mixing plant at the desired consistency than when the cement must first be manufactured from crude or refined asphalt and flux oil. As a general proposition, the promiscuous cutting-back or fluxing of oil asphalts that have been refined to a hardness greater than that desired should be discouraged. While it is not necessarily harmful, and might even be beneficial, it is always at least a subject for close question. The native asphalts are naturally so hard that they require fluxing with some other suitable material before they are usable in asphalt paving at all, so the foregoing remarks do not refer to these materials.

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* Director Paving Dept., Milton L. Hersey Co.

The Filler

The inorganic dust or filler is a factor of prime importance. The material most commonly used is limestone dust pulverized in a grinding mill to such fineness that at least seventy-five per cent. will pass a standard two-hundred mesh testing sieve. When the material is less fine, more must be added to secure a given result; and, as the inorganic dust is usually introduced cold at the mixer into the hot sand of the bulk of the mineral aggregate, the result or using too much of this cold material is obvious. Such mixtures, in that they approach the aggregate of rock asphalt pavements, are also harder to lay in the manner usually employed in the construction of the artificial or American pavement.

Stone dust and portland cement are the most widely used filler materials, the former being the most common because the lower in cost, but the latter being preferred by some on the ground that it is thought to make a superior mixture. When portland cement is employed, the difference in specific gravity between that material and the remainder of the mineral aggregate should be taken into consideration, as the mixtures are usually figured by weight instead of by volume, though the latter would seem a more logical method if it could be used with reasonable convenience.

Other filler materials are pulverized clay, marl, shale, silica, and so forth. Many materials have been tried and found satisfactory, but a few have produced disastrous results. Safety-first demands that a new material be thoroughly investigated before it is used extensively as an asphalt filler. These investigations can only be conducted in a properly equipped laboratory, and by those with comparative experience to draw upon.

The two-hundred mesh sieve is not a sufficient test for an inorganic dust filler, except for routine work on a known material. The particles of dust that are of the most value are those that would pass a five-hundred mesh sieve were one of such fineness of practical value for laboratory testing.

Two-hundred mesh fine sand was offered to the city of Montreal as a filler last season. A deposit of this material, practically all of which would pass the two-hundred mesh sieve, had been uncovered in a local sand pit, and it was offered to the municipal purchasing department at a fancy sand price as a substitute for the more expensive stone dust. It had to be rejected on the ground that, though it passed the specifications under which bids had been received, it was not a proper filler material at all, there being practically none of the finer material for the separation of which no laboratory sieve is practical, and which is the really important factor in a dust filler.

Tests of Material

Photomicrographs saved the day in this instance. It was a rather difficult matter to advise a city purchasing department that the material which passed their specifications better and was about fifty per cent. cheaper than stone dust should not be bought and used; but, when we submitted comparative photomicrographs of the part of each material that had passed the two-hundred mesh sieve, and it was seen that the sand grains looked like rocks under the same magnification that still left the stone dust grains the appearance of fine powder, even the low bidder who was offering the fine sand was satisfied that his material would not serve the purpose.

The air separation dust test is by far the most satisfactory that we have yet found for making comparisons of materials. Water separation gave some good results, but the air method seems more practical. Neither is sufficiently simple to be used on routine work, so the two-hundred mesh sieve must still be relied upon for much of the checking of deliveries with samples submitted. As we do not know of any other air or water separators of the type we are using in Canada, they being especially constructed by us, it is hardly worth while at this time to use these tests in specifications.

Grading Sand

The specially graded sand that forms about seventy-five per cent. of the weight of a standard sheet asphalt pavement surface is a very simple matter if one fully understands and appreciates what is necessary. To fully comprehend the very great difference in an asphalt pavement mixture that the grading of the sand will make, one has but to follow daily on the street the work turned out by a mixing plant where the man in charge is careless of detail, or thinks that any old sand grading at all is good enough.

We have seen a mixture produced by an asphalt paving plant at one o'clock that was all that could be desired, and at four o'clock of the same afternoon that plant was turning out, under the same formula of batch weights, a mixture that was not even third rate. The reason was that no attention was being paid to the sand. At one o'clock, the supply was being drawn from a section of the pile that by chance happened to be of a very good grading, but by four o'clock the laborers had worked into a large pocket where the sand was very coarse.

The result of this carelessness was a poorly graded, sloppy mixture, that could not be expected to give good service under heavy traffic, and that cost as much as the better mixture even for light traffic. It will mark badly in warm weather, and probably shove, whether it has a binder course or not. The quantity of asphalt cement that is correct for a mixture having the standard grading of mineral aggregate is far too much for a mixture in which the sand is coarse. A plant crew that was not well enough organized and trained to watch the sand pile could not be expected to know when the proportion of asphalt cement should have been reduced to prevent a sloppy mixture.

Grades of Sand

Three grades of sand are needed in most cases to sufficiently approximate the standard or model sand grading. These may, for convenience, be termed fine, medium and coarse grade sands for asphalt paving purposes. It may assist the layman in an understanding of the matter if we say that the fine is of that size which is sometimes spoken of as blow sand, the medium a good plasterer's sand, and the coarse a sand of the type we all recognize as suitable for portland cement concrete work.

One sand is occasionally found that is in itself a sufficient approximation of the standard grading; but such cases are rare, and, even then, it is a good precaution to have on hand small stocks of fine and coarse sands for tempering purposes in case the main supply does not at all times prove sufficiently uniform. Sometimes a well-graded sand may be secured from a stratified bank by working a face of a certain depth that will take in layers the mixture of which in falling and handling will give a satisfactory approximation of the model. This we succeeded in doing with good effect last season at Woodstock, Ont.

Fine sand for asphalt paving is one in which there is a decided predominance above the per cent. required in the model grading of those sized grains that will pass a standard eighty mesh and be held on a standard two hundred mesh sieve. The requirement of the model sand grading is thirty-four per cent. of the total sand.

Medium sand for asphalt paving is one in which there is a decided predominance above the per cent. required in the model grading of those sized grains that will pass a standard forty mesh and be held on a standard eighty mesh sieve. The requirement of the model grading for medium sand is forty-three per cent.

Coarse sand for asphalt paving is one in which there is a decided predominance above the per cent. required in the model grading of those sized grains that will pass a standard ten mesh and be held on a standard forty mesh sieve. The requirement of the model grading for coarse sand is twenty-three per cent.

Medium-fine and medium-coarse are the terms applied to sands in which there is a decided predominance above the per cents. required in the model sand grading for two of the sand grades. This quite frequently occurs, and it is in such cases that the standard grading is sometimes sufficiently approached by the mixing of two instead of three separate sands.

Very fine sand is objected to by many on the ground that it usually makes an unstable mixture. In asphalt paving parlance, very fine sand is that which will pass a two hundred mesh sieve but which is not fine enough to be considered dust or filler material. With some of the very finely pulverized fillers that are available to-day, we doubt if this objection is good.

Very fine sand is not filler, however, which was pointed out in a paragraph above, and it must not be allowed to be considered as such in meeting the standard or model grading for sheet asphalt paving mixture. If there is a serious amount of this two hundred mesh sand in the sand aggregate, it should be added to the fine or passing eighty mesh held on two hundred mesh material and deducted from the two hundred mesh material in the mixture to make sure that the model requirement for two hundred mesh material is properly met with inorganic dust filler material. Some specifications, very unfortunately, do not provide for this contingency.

Commercial Sieves and Sand Mixing

Standard sand sieves are used in making screen analyses of asphalt paving aggregates, and not the commercial sieves that may be had on the open market at a low cost, and which serve other purposes quite satisfactorily. Results on these commercial sieves are frequently as much as twenty per cent. off, and such results are of no value to the engineer making asphalt paving mixtures. The two hundred, one hundred and eighty mesh sieves are particularly troublesome, and should be frequently checked for accuracy.

The mixing of three sands at the asphalt paving plant is not a difficult matter. At Saint Foy in Quebec last season, where the province was laying a stone-filled sheet asphalt pavement, we combined five grades of material in the mineral aggregate, exclusive of the filler, without difficulty. The various grades of material are arranged in piles around the boot of the bucket elevator that feeds the heating drum, and then an intelligent laborer can be directed to feed so many shovels of this material and so many of that, and a satisfactory result is secured without additional expense other than possibly half a dollar a day extra to make the man doing the feeding interested in his job.

Location of Sands

The sands for asphalt paving are to be found in almost every locality if one will only look for them. We were told they were not to be had around Montreal, but a survey of the country for fifty miles about uncovered abundance, some in the very deposits from which the city had been getting its supply. Later, the fine sand that had previously been neglected was found within the limits of the city of Montreal, and on city property at that. We have had the same experience with Quebec City and Quebec Province work; and recently, Mr. J. A. Baird, city engineer of Sarnia, Ont., in following our suggestion that he search his own city, has found excellent grades of all the sands required.

Mixing Precautions

The asphalt paving plant has never been more than a very crude machine at its best. We are inclined to insist, wherever possible, upon the standard type, especially the twin-pug mill mixer with a batch capacity of at least one thousand pounds and means arranged above for proportioning the materials entering each batch by the weighing of each material separately.

The mixture should be covered to prevent the loss of the very finest particles of the inorganic dust filler, which are very valuable in the pavement and costly to buy, and so that the mixer platform may be a place where one does not hesitate to ask another human being to work. Most mixers are left uncovered, however, either because the owners do not appreciate the loss of material that is resulting or do not care about the men who must work around them. It is time cities required covers on all mixers.

Steam melted asphalt cement is never burned in the kettles, and direct firing should be avoided wherever possible, and watched with great care where not avoidable. Precautions should also be taken not to maintain the asphalt in a moulten condition for too long a period, for this will cause it to become harder and lose some of its ductility.

Asphalt cement in tank cars should be arranged for whenever possible, as the material may usually be had cheaper this way, and is easier to handle. If there is not sufficient storage capacity at the paving plant, a small quantity of the cement in iron drums should be kept on hand in case of the delay in transit of one of the tanks. Asphalt plants can not afford to stop work during the busy season, as the overhead cost is too high.

Thoroughly mix the aggregate before pouring the asphalt cement into the mixer. The practice of putting the cement in before or at the same time as the dust is dangerous, as the sand is hot enough before being combined with the dust so that after it has lost some of its heat to the cold dust the aggregate will still be of the desired temperature, and this original heat of the sand is too great for a thin film of asphalt cement to stand without damage. If the mixer is covered, there will not be this tendency on the part of the mixer man to put in the asphalt cement first to keep the dust from flying into his face.

Temperature and Analysis

All temperatures at the plant should be watched with the greatest of care, and reasonable uniformity should be insisted upon. An investment in a few thermometers, enough so that one may be placed at every point where it seems desirable, may save the loss of a very large investment in burnt asphalt pavement. Even the most experienced workmen will sometimes burn the mixtures.

The analyses of the mixture should approximate as closely as is possible in good practice the following standard or model:

Bitumen		12%	12%		
Mineral Aggregate Sieve Test Passing	Held on	Model Asphalt Mix		Model Sand Grading	
200	mesh	13%	13%	Not over 5%	
100	200	13%		17%	
80	100	13%	26%	17%	34%
50	80	23%		30%	
40	50	10%	33%	13%	43%
30	40	8%		10%	
20	30	5%		8%	
10	20	3%	16%	5%	23%
8	10	0%	0%	Not over 5%	
Totals		100%	100%	100%	100%

The model sand grading is but the reduction to one hundred per cent. of the sand part of the mixture model, where the sand only forms seventy-five per cent. of the total.

An asphalt paving forumla to produce the approximation of the foregoing mixture, with the usual materials, would be as follows:

Asphalt Cement, pure bitumen	12% or 120 pounds
Stone Dust Filler, 80% 200 mesh	15% or 150 pounds
Sand, specially graded and mixed	73% or 730 pounds
Batch of Mixing	100% or 1000 pounds

Hauling

Hauling mixture to the street is not attended with any very great difficulty. Cities should insist that the wagons be tight enough to prevent the material being dropped all along the route from the plant to the job, and the rest may be safely left to the contractor or city plant, a minimum temperature for laying being provided as a check against poorly compressed work.

Whether wagons or auto trucks will prove most economical is always a local problem. The auto trucks are good for long hauls with steep grades, but there is frequently greater economy in the wagon for short hauls with flat grades. Provisions should be made for the rapid loading and unloading of either, but especially the automobiles. The author remembers figuring on one job that it cost one cent a minute to have a horse drawn wagon of three tons capacity stand for its load, and five cents per minute for a five ton auto truck. After that, we built a loading hopper.

Canvas covers on the trucks are very good at all times, and especially in chilly weather when the crust of the mixture would otherwise become too stiff for proper raking. They should be so arranged that there is a three of four inch air space between the cover and the load, however, as this not only saves the cover but also provides much better protection for the hot mixture.

One cent per inch yard mile is a good formula to remember when considering the cost of hauling asphalt paving mixtures. That is, it cost about one cent to haul enough mixture to lay one square yard of asphalt pavement one inch thick and weighing about one hundred pounds on a street one mile from the mixing plant. Multiply one cent by the thickness in inches of the pavement, and that by the number of miles between the plant and the job. This is a rough and ready rule that should not be used as a basis for a bidding estimate, but it will help in quickly considering the comparative advantages of various available plant sites. It was the basis of a large asphalt hauling contract in New York City, at a time when team hire was six dollars a day.

Where to Dump

The mixture should be dumped on the street on some spot outside of where any part of that particular load is to be laid, and all of it should be handled into place for raking by upturning the shovel at the point of deposit. Asphalt mixtures should not be cast long distances through the air to scatter over the foundation upon which they are to be laid. This is particularly true of those mixtures ranging from stone-filled sheet asphalt to bitulithic, in which such a casting about is likely to cause serious segregation.

Painting abutting surfaces of headers, curbs, manhole and handhole boxes, and so forth, is an old custom, and, we think, a very good one. The asphalt cement used for this purpose should be the same used for making the mixture, and sufficient of it should be applied to be effective. If this detail of the work is worth doing at all, it is worth doing well, and not in the skimpy, careless way we so often witness on both contract and city work.

Sweep the foundation clean before placing the surface upon it. The investment is too great to be endangered by the neglect of a detail that costs so little. The roughened concrete surface that is preferred for asphalt paving requires some care in sweeping to make certain that all the small depressions are reasonably free from dust and dirt and loose material.

Laying the Asphalt

Laying asphalt in the rain is not as serious a matter as one would at first suppose. Experience has demonstrated that sections of pavement laid during quite a heavy rainfall have lasted quite as well as other sections placed when the weather was more favorable. This is not a plea for selecting rainy weather to lay asphalt pavements, but for the costly mixture that is frequently hauled to the dump because some inexperienced engineer thinks a little moisture from above during the laying will cause an asphalt pavement to fail. We do not recommend laying in puddles of water, however. Every possible precaution should be taken to avoid bad weather.

Levelling and raking mixture requires more skill and attention than it usually gets. The raking process should be a kneading into place with the tines of the rake so that about the same weight of mixture will cover each square inch of the foundation. Only in this way can a pavement be laid that will get equal compression under the roller and that will be of equal density throughout. We believe that the depressions in asphalt surfaces are frequently due to the further compression under traffic of those parts of the pavement that are spanned by the wide wheels of the asphalt roller at the time of laying. Certainly a roller riding on two dense knobs of mixture can not properly compress the loose material between.

A true surface is essential in any good paving job, but especially is this necessary with asphalt, where every little fault may be seen so easily. Also, where there are no waves, there can be no rolls, and we often think that may surfaces displace partly because the original workmanship left the beginning of the wavey condition that later becomes so objectionable. A long straightedge, ten feet or more, constantly in use, will do much for any paving job.

The straight-line crown is used more extensively each year with all types of pavements, but it has special advantages in the case of asphalt where there is so much objection to the little shallow puddles of water that form on the centre of other crowns directly following a rain storm. The purpose of the crown is to shed water, and it should be made to do that as effectively as possible with the least possible drop from a horizontal line. One quarter of an inch to the foot is sufficient where a straight line crown is used and the surfacing work well done.

Gutters and the Street Car Rail

Gutters should be asphalted to the curb. There is no reason for placing a cement or brick gutter on an asphalt street. Whether of asphalt, cement or brick, the gutter should rise at the rate of one inch to the foot or better for the first two or three feet from the curb in order to form a decided dish that will confine the water in a narrow stream against the curbing instead of permitting it to spread several feet out therefrom. If the same care had been used in forming asphalt gutters with the proper rise that was used in laying cement or brick gutters on asphalt streets, no one would ever have thought it necessary to employ the other materials. The flat asphalt gutters of early construction have much for which to answer. Proper gutters can be formed and compressed with a tamper, and a good roller man can get in to them effectively.

Asphalt to the street car rail wherever the street railway roadbed is good. Where it is poor, if possible, compel them to make it what it should be. There is something very disfiguring about a ribbon of blocks along an outer rail on an asphalted street, and it is absolutely unnecessary in many cases. It has always appealed to me as diabolically clever the way in which the asphalt promoters have persuaded cities to lay block pavements along car rails, knowing that whatever was laid would go to pieces where the rail construction was bad, and thereby avoiding the discredit that would unavoidably, though unjustly, fall upon asphalt, shunting it over upon the other material.

Maintenance

First construct then maintain your asphalt pavements. They should not require any repairs for a number of years after laying, except where some defect in construction comes to light, but whatever they do need they should get. Repairs should be carefully made, with perpendicular edges and properly painted joints, and no asphalt repair should be left higher than the surrounding surface. If properly compressed in the making, there will be no sinkage under traffic that will require an allowance. Do not leave the surface higher than the car rails, manhole boxes, and so forth, against which it is laid. This has been tried out and abandoned.

Three methods of maintenance for asphalt pavement surfaces should be considered. There is the simplest way, the cutting out of the defective section and replacing it with new mixture. The surface burner method has been used extensively, with fair results. And the remelting and remixing process has been successfully employed in many places. Needless to say, all three methods should be used in every large city, each being fitted to different conditions that are sure to confront the engineer.

The remelting and remixing of the old surfaces has always seemed to the author the one way that should be more carefully developed with a view to the future maintenance of our asphalt pavements. The re-use of the old material, which can be made as good as ever at little cost by remelting and remixing, with possibly a little added soft asphalt to rejuvenate it, will effect great economies in street pavement maintenance over a period of years. The cost of new material is saved, and the expense of hauling the old surface to a dump is avoided. The trucks must return to the mixing plant anyway, and they may as well carry a load of old asphalt as go back empty for the next load of mixture.

Predicted Use of Asphalt

Asphalt is in its infancy as a paving material. Each year sees larger tonnages of it used for this purpose, and, as paving economy is more carefully studied by our public authorities, the very clear reasons for its extensive employment as a road surface material will be more fully appreciated. The more extensively it is used in any city, the more economically it can be handled.

Conclusion

This paper is already too long and must therefore be brought to a close, but the subject has only been partly treated in a way that the author hopes will be helpful to those who are about to get their first experience with asphalt pavements. To those who have spent many years in the industry, it will mostly be an old story, and only a very small part of the old story at that; but to the young engineers who are about to start their careers as road builders, and to the older members of the profession who have heretofore not had to consider the subject very carefully, it is hoped it may supply some idea of the practical side of the work, and a slight insight into the technical side.

Plans and specifications are now being prepared for a new munitions plant in Toronto. The site, which has recently been purchased, is located in East Toronto near the G. T. R. and covers an area of 3¾ acres. It is stated that the machinery alone will cost $360,000.

Tractor Specifications

The directors of the Highland and Agricultural Society of Scotland held a tractor demonstration in July of last year. A summary of their conclusions follows:

Weight.—The weight of tractor should not exceed 30 cwt.

Horse-power.—Should be ample; not less than 20 brake horse-power.

Caterpillars and Wheels.—Caterpillar tracks have not been shown to possess any advantage, in gripping power, over the best type of wheels.

Spikes, Bars, and Spuds.—Well-designed spuds appear preferable to either spikes or bars.

Accessibility and Protection.—Working parts of machinery should be readily accessible. Complete protection against weather and interference should be provided.

Brakes.—Adequate brakes should be fitted.

Durability.—Exposed gear drives on wheel tractors and excessive wear on caterpillar tracks tend to impair durability.

Connections.—Spring attachment between tractor and plow desirable, with release device in case of severe shocks. Point of attachment should be variable vertically as well as horizontally.

Speeds.—Two and a half and four miles per hour forward, with reverse, appear to be the most generally useful.

Fuel.—Complete vaporization of paraffin does not appear to have been generally attained, and it may be found more satisfactory to use petrol when normal conditions return.

Handling and Turning.—Handling does not usually prove difficult. Single-unit machines have the advantage that the implement operated is directly under the observation of the driver. Lighter tractors and single-unit machines occupy less time and space in turning.

Price.—The price should not exceed £300.

Plows.—Must be adjustable to varying widths as well as to varying depths. Where the tractor and plow do not form a single unit, it is highly desirable that an automatic lift should be provided. Power lift has additional advantages. A guide wheel to regulate width of leading furrow is desirable. Suggestions—(1) A device for raising the last unit of the plow would enable, say, two furrows to be taken up-hill and three down; (2) a one-way plow would abolish feerings and finishes, which, in most cases, must be done by horses.

Your Concrete "Bit"

It's the nature of man to delay if he can
The duties he knows he should do,
He'll find an excuse, though it's poor and obtuse,
And flatter himself that it's true.
Intentions amount, in the final account,
To hopes that have wandered astray,
But a thing that's begun, is as good as half done,
For at least it is well under way.

You grumble and wait for the incoming freight,
That's bringing your lime and cement;
It's sidetracked out there on the system somewhere
For schedules are twisted and bent;
Each morning you find you are getting behind,
With the building that ought to be through,
So you worry and fuss because some other cuss
Is making work harder for you.

I've preached it before, and I'll say it some more,
That you are the fellow to blame,
For when you build roads that will carry the loads,
You'll put the freight schedules to shame;
A permanent street made of lasting concrete,
With freight loaded trucks running through,
Will give you relief from your train waiting grief,
And settle the problem for you.

L'Envoi.

It's the nature of man to delay if he can
The things he should do right away,
So it's right up to you to get busy and do
Your "bit" for the concrete highway.

By F. A. Mitchell—Cement World

The Central Engineering Company, Limited, has taken out supplementary letters patent increasing its capital from $25,000 to $100,000.

Water Purification by Ozone Method

An interesting article on the treatment of water with ozone, written by Mr. I. D. Groak, of Chicago, appeared in Municipal Engineering of May, 1918.

Ozone is the strong, powerful gas, known chemically by O_3. It was used first for water purification by Shoenbein, in about 1849. The project was taken up on a commercial scale by Siemens and Halske, in 1898, and in a short time after a number of plants were installed in Europe; and to-day about 60 or 70 municipal plants are using the ozone method of water purification in France, Italy, Russia, Roumania, and Germany, and even in South America.

The first plant was in Paderborn, Germany, where typhoid has entirely disappeared from the town. Petrograd, Russia, and Munich, Germany, use ozone for large breweries and industrial plants, and Astrachan for sterilizing mineral water. In France alone, in 1915, there were 26 plants working, including that of Paris. Besides Siemens Halske, Tindal, whose patents passed into the hands of M. de Frise, who improved on them, also Otto, and several others worked and made improvements. Vosamaer spent about 15 years of scientific study on the use of ozone for water purification and other industries

The application of ozone in water treatment depends on the properties of the water itself. It is preferable to make the water clear of matters in suspension. It makes quite a difference for the designer of a plant whether he has to contend with river water, lake or well supply. Ozone itself, if properly handled, will reduce the turbidity due to organic matters about 70 per cent., but it is cheaper to do that with rough filtration, and let the ozone act on the bacteria and organic impurities.

Nature of the Process

How does ozone act on the water? Just as in nature. Both before and after a rain we smell ozone; as the rain water comes in drops every part of it is touched by the ozonated air.

Science has put into commercial form the imitation of this occurrence. We all know that through either seepage, vegetation, or sewage contamination there is hardly any water which is not contaminated with harmful bacteria. Ozone mixed with this water will discharge one part of oxygen in so-called status nascendi. This part of oxygen makes a combination with the carbon of the organic impurities, burning them up into CO_2, and literally removes the harmful and odor bacteria from the water and produces not only a safe, but palatable, crystal-clear, oxygenated water.

Naturally it took some time before a process was worked out on a commercial scale in such a way that now it is possible to produce and to manufacture an apparatus for a reasonable amount and small upkeep. The most important part of the equipment is the ozone generator. A Chicago company claims to have an efficient and inexpensive ozone generator, consisting of a vacuum tube, which is made from glass (see Fig. 1). Around this vacuum tube there is another glass with metal contact. About 5,500 volts or more of alternating current, in passing through these, produces a silent discharge of electricity. The proper name is "brush discharge"; sparking would produce nitrites, which are harmful. This brush discharge makes ozone from air. Conveying this ozonated air in the mixing chamber or sterilizing towers is another secret of reproducing nature's own water purification.

The Action of Ozone

It is not only important to have pure ozone and have a simple device for making it, but equally as necessary to have an efficient mixing device to use up every particle of the ozone and to make sure that all molecules of the water shall be thoroughly mixed and in touch for at least a short period, by passing the water through the mixing or sterilization chamber. The air should be filtered and dried before entering.

First, it destroys the pathogenic, less resistant bacteria. On a commercial scale it is not advisable to go too far with the process. To give an idea of how much ozone is required to treat the water, anywhere from one-half to three grams per cubic meter of air is the general method for concentration. Regarding the output of ozone per horse-power employed, 25 to 30 grams, sometimes even up to as high as 35 grams, is an average for rate of production.

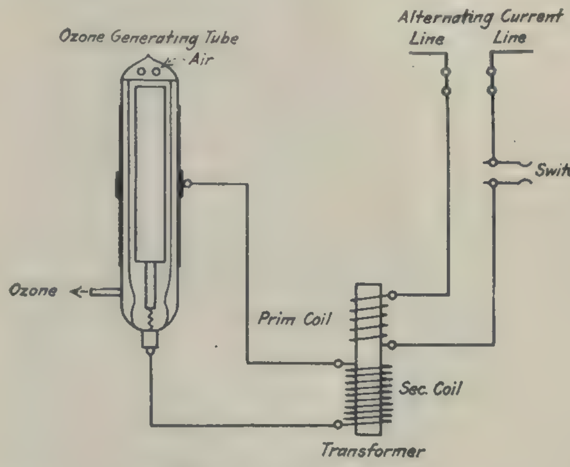


Diagram of ozone generator.

The space required for the apparatus is very small. Each tube has a capacity of 30 to 200 gallons of water per hour; its electric consumption is about 2 watts. It merely means a duplication and many sets of tubes and mixing chambers for a larger plant. The results are positive, without any question or doubt as to the outcome. The process has proved itself in the last decade. It not only disposes of the bacteria, but takes out the odor and improves the taste of drinking water, without leaving any residue or chemicals in the tap water, and hardly changing the mineral content of the water.

The Process as Viewed by European Authorities

Quoting from Don & Chisholm, of "Modern Methods of Water Purification," pages 202-3, they say: "Naturally, a purification process which converts an unwholesome stream into a liquid as certainly inoffensive as the purest spring water is one that appeals directly to water undertakers. . . . . The consumer cannot find fault with the treatment, for no residue of the purifying agent is left in the tap water. . . . It is an ideal procedure."

With reference to the treatment of river water we are quoting the following: "The results obtained were upon the roughly-filtered Marne water. The latter carries at times as many as 300 bacteria per c.c., and B. Coli is discoverable in 40 c.c. The color of the water is dull, with a brown to greenish hue. The water that comes from the sterilizer is bright and sparkling, and highly transparent. The perceptible odor at the sterilizer is almost entirely vanquished before it is ready to flow away from the last compartment. There is no increase in nitrates in the ozonized water as compared with the filtered water, nor are there any nitrites, chlorine compounds, or any peroxide of hydrogen traceable to the electric discharge. These are the conclusions drawn by Drs. Ogier and Bonjean (1904) and by Dr. Rideal (1908)."

In some plants water contains over 4,000 bacteria per c.c., and is made safe with ozone treatment.

"In Ginnekin, Holland, the ozone treatment reverses the vitiated condition of the water, and produces an effluent which is not only to all intents sterile, but is clear, sparkling, and, to use the description of Professor Gerard, appetizing. It has acquired all the properties of the best upland water, which is only distinguishable to the chemist."

Practical Ideas on Repairing Bridges

At the twenty-seventh annual convention of the American Railway Association, the president, Mr. S. C. Tanner, gave some interesting details on the repair of bridge piers. Mr. Tanner's remarks are reproduced in part:

We found on some of the old main lines, where stone piers had been built 30 or 40 years ago for pony trusses, that the piers held up the pony trusses all right, but when the bridges had been renewed either with pony steel trusses or deck girders for heavier traffic, the ends of the piers would settle down or the middle of the piers would break down. As a temporary expedient in those cases I used an idea that I had gotten from some old bridge man of putting longitudinal timbers from end to end of the pier. That had the effect on the piers under the pony trusses of throwing towards the centre some of the load that was settling down the end of the pier, and under deck girders of throwing out to the end of the pier some of the load that was breaking down the middle. That was then followed up, sometimes several years later, by taking down one or two courses off the top of the pier and putting in a new reinforced concrete cap, and I don't know of one case in ten years on that railroad where I took down a few courses from the top of the pier and put in a reinforced concrete top that would distribute the load over the pier, where we had any further trouble or any further settlement.

We also had cases where the back-filling of the pier behind the casing was very soft and was breaking down under the loads. We ran tie-rods through such piers and put a casing 6 to 9 in. thick on each side, and we had no further trouble there.

Concrete Placed With Old Bridge in Use

One lesson I learned there was the remarkable bond that forms between new concrete being placed, and old masonry in those piers, even though the old masonry may be moving at the time of placing the new concrete. The first question I was asked was: "How is this concreting to be placed while the bridge is in use and the old masonry moving?" Now, in practically every instance we concreted while the old bridge was in daily use and, even though there was a considerable movement of the old pier, the new concrete set firmly.

This set is really remarkable. Perhaps the most extreme case where a movement has been stopped and the concrete has set was on the long approach to the St. Charles Bridge, over the Missouri River, on the Wabash Railroad. There is a long curved approach there, and trains going around the curve would throw the track out of line sometimes as much as 6 in. The chief engineer of the Wabash finally struck upon the idea of changing these old columns into concrete columns. He put an 18 in. form around them and wound them with wire and rods, and built the columns up from the bottom, storey by storey, from the bottom to the top. When he was a quarter of the way up one-quarter of the lateral vibration had disappeared, and when he got to the top the lateral vibration had entirely disappeared. That concrete is apparently just as good as though it had been placed under a bridge that was perfectly still instead of one sustaining a heavy traffic.

Another case I found at Little Rock, Ark., where a bridge across the Arkansas River had piers made up of about 35 ft. of timber cribbing and 45 ft. of masonry on top of pneumatic caissons on rock. The cribs were not really well built in the first place, and the sand had leaked out through the cracks. The timbers gradually had crushed and let those piers down, and they were pointing in every conceivable direction. From 1883 until about 1907, when I took over the responsibility for the bridge, I think about five efforts had been made to stop those piers from moving around.

In 1912 we went in and sank cofferdams about them, went down to a depth of 45 ft., removed all the sand and rip-rap, and while those piers were moving around a good deal, we gradually put in concrete and began to build up, and as the concrete went in one could almost note the disappearance of the vibration. When we got up to the top the piers were solid. When trains went over before, the timbers were soggy, and you could see the water squeeze out of them. When we reached the top of the timbers we put a reinforced concrete shell around the piers, and those piers have been there now for five years and they are just as solid as rock.

Repaired 150 Bridges

In 1907 I had 150 bridges on that railroad under which the piers were moving, for every conceivable reason, and I don't remember one case where we took down a pier or abutment because it was moving. In every case we resorted to some of the expedients reported by Mr. Strouse, and we never hesitated, even on a smooth concrete face of an abutment, to drill in, put in anchor rods, and put the shell in front of that.

We had another case where we encased some steel cylinders in concrete. We had a number of piers, each composed of two steel cylinders, and each having seven piles driven down through the cylinders. We wanted to put a heavier truss on and we had to reinforce those cylinders some way. Without any falsework at all, we went down around those cylinders, drove the piles to about 40 ft. penetration by the jet, put the cofferdams down, and came right up around those cylinders and buried them in concrete.

When we jetted a pile down at one side of the cylinder the cylinder settled about half an inch, so we would drive so many piles on one side and then go around and drive so many on the other side to keep it from getting too much on one side or the other, and when we got through we found the cylinders, every one of them, had gone down about 12 to 14 in. The mass of concrete was so great in comparison to the size of the cylinders that the weight of the concrete overcame the motion as it came up on the cylinders which were vibrating under traffic.

In a number of cases we had concrete arches built for one or two tracks. Sometimes the head-walls were pretty well out at the foot of the slope and pulling away. Now, in three cases I remember distinctly I put across the head-walls, about 3 ft. below the crown, a pair of heavy I-beams, and ran rods through from one set of I-beams to another. On one bridge we were sure we were going to lose immediately we spent about $3,000 putting in a set of I-beams and a set of rods five years ago. I took a trip there recently and there has not been a particle of motion since we tightened up the rods. It is as stable as though it had been built right. Nobody sees the arches, but the bridge inspector, and he doesn't care, so the appearance does not matter. To have rebuilt the arches would have cost $50,000.

Discussion

A. S. Markley:—The Chicago and Eastern Illinois had four through truss spans, each 150 ft. long and one 166 ft. plate girder draw span crossing the Wabash River at Clinton, Ind. The masonry supporting this bridge was built of native stone in 1870. The stone had deteriorated and began to show defects under the truss bearings on account of the heavy live and dead loads. For this reason it was decided in 1910 to strengthen all the five piers, the south abutment and tail wall, and a detached tail wall and to build an additional abutment for a 24 ft. beam opening to replace a wooden trestle for an under crossing for teams at a total estimated cost of $19,490.

The actual cost of this work, without overhead charges on car rental, was $20,850. During the work the operator was interrupted twice by high water and once to do other important work, which no doubt absorbed the overcharge. Work was begun in September, 1910, and completed in September, 1911, the cost per pier ranging from $3,019 to $2,638.

All of the masonry in the old piers and abutments was veneered with reinforced concrete 18 in. thick.

Cost of concrete per yard for casing:

Material, per yard of concrete	$ 1.84
Labor, per yard of concrete	1.49
Total	$3.33
Cost per yard of concrete, labor	$ 6.49
Cost per yard of concrete, material	4.40
Total cost of labor and material (casing included)	$10.89

In order to take care of the additional dead load of the concrete 30 ft. piles were driven 36 in. between centres around the outside of these piers and the abutment, the latter being 30 ft. long and 42 ft. high from base of rail to low water mark. In driving these piles the leads and steam hammer were suspended below the bridge, a Bay City driver and steam hammer being used. A short boom derrick with a two-drum and winch-head machine was placed on the front of the driver to handle the leads, hammer, and piles. The driver was self-propelling, dispensing with a train crew and locomotive. All piles were driven home to receive the concrete and below low water line. Double rows of the sheet piling were driven around the piers and 2½ ft. away from it, the space between being filled with straw and sand to insure that there would be only dead water inside of the cofferdam to avoid any cement flowing away. The inside casing of the cofferdam comprised the form for the concrete, which was placed a minimum thickness of 4 in. outside of the piles, so that no part of the piles was exposed to the atmosphere or other destructive agents. The water around the piles was from 8 to 12 ft. deep. In some cases the piers had been filled around with broken stone to prevent washing, which very much impeded our work of driving the sheet piling.

Placing Concrete Under Water

In order to deposit the concrete in the water we used a 10 in. tube made of No. 22 iron, riveted together with a barrow hopper at the top, in which to dump concrete from barrows into the tube. In using this it was necessary to seal the tube on the bottom or keep enough concrete in it to prevent the water from rising in it and separating the sand from the concrete. As the tube was filled it was moved to one side or raised sufficiently to allow the concrete to pass out of it in place.

The concrete was allowed to settle around the piles and make its own slope from the inside of the sheet piling down under the pier. In some cases there were openings that took considerable quantities of concrete to form the footing up to the grillage, all of which added to the support of the increased dead load. The piers in all cases rested on piles and grillage. While this work was going on no discoloration of the water inside the cofferdam was visible, the cement and other ingredients remaining where they were deposited. These footings, in some cases, were 2 to 3 ft. wider than necessary to support the 18 in. veneer on account of the grillage being wider than the piers. In these cases we stepped in to the required width. The upper forms rested on and were anchored to the footings and were tied at the top to prevent their spreading as concrete was deposited in the forms. In order to anchor the concrete to the old piers ¾ in. corrugated bars were placed 36 in. apart. Holes were drilled in the stone 12 in. deep, in which the bars were inserted. They also extended 12 in. into the concrete. After dampening the holes a rich mortar was packed in them around the bars, to anchor them to the pier. In addition a dovetailed recess was cut in the stretcher course of masonry for the full thickness of the course, from 18 in. to 24 in. thick and as deep as the stone was wide. Stretchers were selected on account of their being narrow to minimize cutting. After the recesses were cut, concrete was brought up and an extra thin grout was run into them to fill up the voids that appeared in the masonry, which were many and some quite large. As the stone was laid in mortar, where recesses were not opposite each other, grout would appear on the opposite side from which it entered the pier as the grouting progressed. The veneer was properly reinforced in both directions, in addition to being anchored to the pier.

Bearing blocks under the trusses on top of the piers were made in the field and were properly seasoned before placing. The joints in the masonry always determined their thickness, the minimum being 4 ft. thick and 24 in. wider than the shoe of the truss. Parallel with the track the blocks extended 12 in. on to the veneer on each end, leaving 6 in. of the end of the block to be covered up with veneer, so as not to show the joints of the block on the face of the pier. All these blocks were heavily reinforced and placed under traffic, using a self-propelling derrick to place them. All work done at this time is as perfect as when completed, no blemish whatever having appeared. At the same time new coping was added to all the piers and abutments. At several other double-track truss bridges we have had this same defect, bearing blocks replacing the old stone piers where evidence of defects appeared. We have usually coped the entire pier or abutment down, in some cases as far as two courses below the coping. We use two 50-ton ratchet jacks under one end of each span, with loops made to fit over the nuts of the end pins, with stems sufficient in length and strength to carry the weight crosswise of the track. Heavy timber or I-beams were used on top of the jacks to raise the trusses. The stem of the loop passed through the timber, with nuts and a plat on top or between the beams.

We had two 12 ft. arches with 6 ft. bench walls in which the stone had deteriorated to such an extent that it was necessary to strengthen them. The barrels of these arches were 45 ft. long. In one we placed reinforced concrete 12 in. thick. In order to place the concrete, which was made reasonably thin, we tapped a hole 24 in. square in the crown of the arch between the two main tracks and outside of the ties, in which to pour the concrete, beginning in the centre and using 1 in. by 6 in. plank to tamp the concrete in place between the corrugated bars.

At the second arch we used three rings of paving bricks made of ground shale, beginning in the middle with centres 30 in. apart, or sufficient for men to work between. As the brick was laid in the crown roller ways, the lagging was placed in sections, keeping the brick in reach of the men laying them. As both arches were duplicates, we saved $150 by using brick which cost $12 per M. In laying the brick, very thin cement mortar was used. When the brick were "buttered" they would be slid 12 in. to 15 in. on the mortar bed into place, thus insuring a perfect joint. The space between the old and the new crowns was backed up with spaces of brick and mortar.

We have four or five brick arches which were built in 1896. Upon recent inspection they were found to be as perfect as when put in, except the footings of concrete. There is no leaking of the roofs or bench walls. They were coated over the top with a rich mortar 2 in. thick at the time they were built. No extremes of temperature or combination of freezing and thawing of water have had any effect whatever on their durability.

One of the first actions of the new Department of Municipal Affairs of the Province of Quebec is to quash by-laws passed by the towns of Pointe-aux Trembles and Laval de Montreal guaranteeing loans to be floated by several companies who proposed to build factories in these localities. Municipalities around Montreal have been very generous in thus assisting companies, and the Quebec Government evidently is of opinion that a halt must be called to this method of attracting industries.

Another Use for Concrete

In the city of Three Rivers, P.Q., La Compagnie de Beton Special, Ltee., is manufacturing various kinds of sanitary vessels of concrete. These include bath tubs, sinks, lavatories, cheese dairy baths, eating and drinking basins for animals, etc. Fig. 1 indicates in a general way the method of moulding. When closing the mould, the base, A B, is under, the inside form and outside plank closed and fastened. The concrete is a 1:1 mixture with 2 per cent. of Toxement added. This is poured in from the top and spread over the inside form to the proper thickness. The part E D is a frame running round the top of the form, inside of which is placed a cover, F, G, I, H, called a compressor, which is forced into place when the concrete has been well rammed into the mould. The pressure acting on this compressor is calculated as a vibrating force of 150 lbs. A complete moulding operation lasts from 20 to 30 minutes. At the end of this time the mould is turned over on its frame with the base up, as shown in Fig. 2, the sides of the form are dropped and the inner form removed.

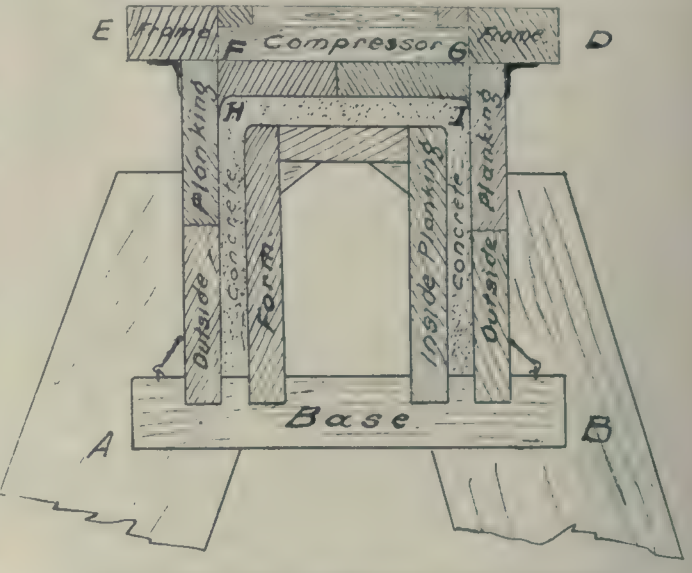


Fig. 1—Concrete rotary moulding form, during the setting.

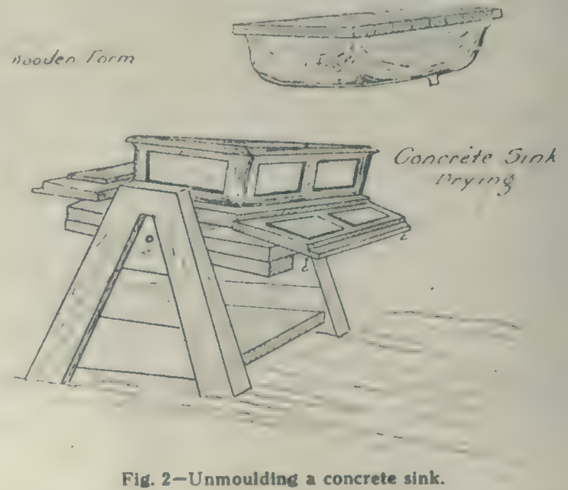
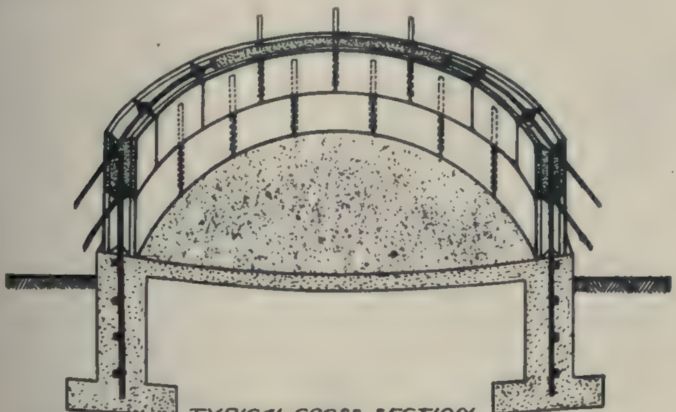


Fig. 2—Unmoulding a concrete sink.

In addition to the Toxement, waterproofness is assured by three coatings of special waterproofing paint, which gives the concrete an exterior appearance similar to any enamelled bath. This coating is approximately 1/16 in. thick. A glazing is afterwards applied. The work is done very largely by hand and it is estimated that one man can mould ten tubs per day.

Patented Reinforced Concrete Tile*

Messrs. J. B. Nicholson, Ltd., civil engineers and contractors, Hamilton, Ont., have devised a new patented tile, illustrated herewith, which is designed to overcome the cost of form work. It consists essentially of a reinforced concrete tile or slab 18 in. in length, 12 in. in height, and of varying thicknesses—4 in. to 8 in. Around the 4 in. edge is a 2 in. V-shaped groove, which forms, when two tiles come together, a diamond-shaped opening, which is filled with concrete grout. In this space, both vertically and horizontally, is placed the required cross-sectional area of steel reinforcing. The vertical steel runs partly through this groove and partly through a circular opening, cast in the centre of the tile at time of manufacture.



TYPICAL CROSS SECTION
CIRCULAR REINFORCED CONCRETE UNIT CONSTRUCTION
SHOWING
ASSEMBLY OF UNITS—REINFORCING & FOUNDATION

The field to be covered with this class of construction is the erection of reinforced concrete grain elevators, coal pockets, fuel oil tanks ,and water tanks, and retaining walls where great pressure has to be designed for. The tile are manufactured both at a central point for smaller contracts and locally on the job for larger works.

A Record Membership Campaign

The Toronto section has just achieved a new record among the thirty-three sections of the American Institute of Electrical Engineers. Fifty-two new applications for membership have been filed during the campaign, which ended on April 30 last. This corresponds to an increase of about 25 per cent., and, we understand, is ahead of that of any other section, and testifies to the appreciation in which the membership in the Institute is held. Non-members often do not realize that a distinct advantage is associated with membership in the Institute. The opportunity given for associating with members of the same profession in different grades is of inestimable value. Great credit is due to Mr. A. B. Cooper and his membership committee for the results obtained. We are advised that the actual number (as distinct from the percentage) of members signed up in Toronto was surpassed only by Philadelphia and Pittsburg.

Mr. J. S. Archibald has resigned from the Architectural Commission of the City of Westmount, on his appointment as member of the Montreal Tramways Commission. The Architectural Commission passes on all building plans.

Mainly Constructional

East and West—From Coast to Coast

Building permits amounting to $10,000 in value were issued in Galt, Ont., during April. Five of these were for dwellings.

Works Commissioner Harris, of Toronto, states that the Bloor Street Viaduct will probably be ready for traffic in the early autumn if not sooner.

The Shand Engineering & Contracting Company, Limited, has been incorporated, with a capital of $40,000, head office at Sault Ste. Marie, Ont.

The municipalities interested have received assurances from Ottawa that the Port Dover, Ont., harbor will be improved and that the work may be expected to begin this year.

There is approximately 200 miles of new road construction proposed to be done in the Province of Manitoba this year, the carrying out of which will depend very largely on the availability of labor.

The Barrett Company, Limited, have commenced work on their paving contract on the Marsh Road, from the One Mile House to the Three Mile House, near St. John, N.B. The surface will be laid 16 feet wide and will have gravel shoulders.

The smelter at Midland, Ont., is to be reconstructed and again put in operation. Cleveland capitalists and a number of local men, including Mr. James Playfair, are interested. The Arthur G. McKee Company have the contract for carrying out the construction work.

The Steamer Lake Michigan, which sank recently, had on board repair parts for one of the city of Regina's electric light units. The improbability of receiving repairs before next winter's heavy demand may mean the city will have to expend from $175,000 to $200,000 for the purchase of a new unit.

A new roadway of first class construction is to be laid at Guelph, Ont. The contract, which has been awarded to the Construction & Paving Company, of Toronto, calls for a bituminous concrete road from the G. T. R. subway to the River Speed at the Dundas head bridge. The whole work will cost $23,300.

Within the next few weeks the McAvity machine plant at St. John, N.B., will have another unit, 100 ft. x 400 ft., added to its present building. The addition will be constructed of reinforced concrete and brick and will be placed immediately in the rear of the present plant. Grant & Horne, contractors, have the work in charge and F. Neil Brodie is the architect.

The contract recently awarded to J. B. Nicholson, Ltd., by the Kerr Milling Company, Dundas, covers a 24,000-bushel elevator, consisting of four circular reinforced concrete pockets, 14 ft. diameter, 50 ft. high, constructed of the Nicholson patented reinforced concrete tile; also underground tunnels, concrete track copper, elevators, conveyors, distribution system, and miscellaneous equipment, the whole construction being either of reinforced concrete or steel and absolutely fireproof.

The Saskatchewan provincial department of highways is calling for tenders for two reinforced concrete bridge abutments for a bridge over the Assiniboine River near Cote on the C. N. R., two reinforced concrete bridge abutments for a bridge over the Maple Creek near the town of Maple Creek, and for two similar abutments for bridges over the

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Patent No. 183597 April 1918.

Qu'Appelle River near Disley, on the C. N. R. Contracts are to be let separately for each work and will be received up till May 20.

At a recent session of the New Toronto Council, the question of modifying the building by-law was brought up. The present provisions only permit the building of solid brick houses south of the Lake Shore Road, and the landowners are anxious to have less stringent regulations in order to put up immediate buildings. The matter was shelved for further consideration.

The value of building permits issued during April in Regina, Sask., amounted to $29,310, making the total for the year to date $475,660, or approximately $60,000 more than the value of the entire building program carried out in 1917.

Vancouver's building permits for April number 91 and are valued at $163,230, as compared with 49 permits at a value of $73,824 for the same month last year. The permits for the first four months of this year also compare favorably with those issued during the corresponding period in 1917, the figures being respectively, 244 permits valued at $344,710, and 168 valued at $233,364.

The Hydro-electric Power Commission of Ontario have been granted permission by the Ontario Railway and Municipal Board to build a railway from Chippewa through the township of Stamford for the purpose of removing the excavated material, etc., from the site of the Chippewa power development. The railway is to be constructed as soon as the plant is completed.

Trouble has been experienced at Aylmer, Ont., owing to the water from the neighboring creek flowing into the town reservoir on the flats near the power house every time there is a freshet. County engineer J. A. Bell has been called to investigate the conditions. He will prepare new plans and specifications and it is probable that a new reservoir will have to be constructed.

The building permits issued in Guelph, Ont., up to the end of April total $40,930. While this does not indicate any great activity in the trade, it gives promise of a much better season than 1917, being within $2,000 of the total for the whole of that year. There are several residences in course of erection in different parts of the city, while a large number of repairs and additions are also being made.

The establishment of minimum building restrictions for the province at large, with power vested in municipalities to further control building operations with a view to eliminating fires, was suggested at the recent meeting of the Fire Insurance Commission at the Parliament Buildings in Toronto, by City Architect Pearse. He also recommended that the sale of fireworks be made illegal. Mr. J. A. Robertson, secretary of the Canadian Fire Underwriters' Association, declared that the primary cause of fires in America was the carelessness of the people. For 1916, in America, 28 per cent. of the fires were preventable. Using these figures as a basis, he estimated that Canada had a fire loss of $6,100,000 due to carelessness. Fires partly preventable had cost the country $10,300,000. The comparative figures of fire loss in Canada and that in other countries were as follows: Canada, 3.58; United States, 2.32; England, .67; France, .63; Germany, .17.

Mr. John Quinlan, contractor, has just recovered $134,355.17 in an action in which he sued the Protestant Board of School Commissioners of Montreal for $198,605, claimed to be due him under contract for the excavation and foundation work of the Protestant High School and Administrative Buildings on University Street, Montreal. The chief claims of the plaintiff were that the plan based on the borings made for defendant on the high school site were misleading and inaccurate; that the variable nature of the soil and unforeseen conditions in the site of the administrative building necessitated further changes in the plans of the foundations; that the prices for excavation in the site of the administration building in the original contract were not applicable to the work as carried out; that the extra work done and extra material furnished by the plaintiff for the defendant entitled him to recover an additional sum of $190,746 over and above the original contract. As noted above, judgment was rendered for the contract or for $134,355.17.

Trade Publication

The Armstrong Cork & Insulation Company, of Pittsburgh, have issued an interesting little folder entitled, "Satisfaction Or—," which deals with the subject of industrial drinking water systems. The necessity of supplying ample quantities of pure, fresh water to workmen is well recognized and the system of distribution described by this company in their booklet is timely.

Buffalo Forges—The Buffalo Forge Company, Buffalo, N.Y., are distributing a booklet describing various types of Buffalo forges and blowers. This booklet forms Section No. 100 of the company's catalog, and contains 111 pages. The plan now followed by the company, in order to simplify the catalog and also to keep up with improvements which are made from time to time, is to replace the bulky catalog with sections, which are easily and quickly replaced without affecting the rest of the catalog.

Personals

Mr. W. H. Eassie has resigned his position as city engineer of Cranbrook, B.C.

Major E. W. W. Doane, formerly city engineer of Halifax, has been requested to return from overseas to assist in the reconstruction work at that city.

Mr. W. R. Daye, who has had charge of advertising for T. McAvity & Sons since Mr. Erb enlisted, has also joined the colors. The McAvity list of soldier boys is nearing the 100 per cent. capacity mark.

Mr. A. W. Smith has resigned as secretary-treasurer of the Manitoba branch of the Canadian Society of Civil Engineers, and the duties of this office have now been taken over by Mr. G. L. Guy, M.Can.Soc.C.E.

Mr. E. S. Fraser, town engineer of New Glasgow, N.S., has been presented with an engraved gold watch by the citizens of Dartmouth, in recognition of the assistance rendered by him following the Halifax disaster.

Capt. T. S. Scott, of No. 5 F.C.C.E., was recently ordered to report at Halifax to aid in the reconstruction work in that city. Capt. Scott has been professor of civil engineering at Queen's University for several years.

Mr. T. P. Howard, managing director of the Phoenix Bridge and Iron Works, Montreal, who has been connected with the Britsh War Mission, Washington, has been appointed deputy director of war supplies for Great Britain.

Geo. F. Heidman has resigned as building inspector for the city of Stratford, Ont. Mr. Heidman had been holding this position and at the same time acting as electrical inspector for the Hydro Commission. He will now devote all his time to his work for the Commission.

Obituary

Edward F. Fauquier, a prominent railway contractor, died recently in Ottawa at the age of 63 years.

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Heat Transmission of Building Materials

IN a recent bulletin published by the University of Illinois interesting data is published from experiments designed to determine the coefficients of heat transmission of standard building materials under practical conditions. The experiments were carried out on the more commonly-used walls, the figures for compound and special walls being deduced.

Heat passes through a wall by conduction, provided that the temperature on one side of a wall is higher than on another. Radiation and convection are the other main factors in heat transmission. Elaborate tests are being made, using five different methods. The results so far obtained are as follows:

1. For determining the transmission coefficient, air to air, and the outside surface coefficient, mercury, thermometers may be used and, if properly installed, will give results of practically the same accuracy as those determined with the thermocouples. Mercury thermometer wells were shown to be of no value in determining surface temperatures. The method finally adopted was to imbed the thermometer in the surface so that its centre line would lie in the plane of the surface of the material being tested. Thermocouples are to be preferred for determining temperatures in this work.

2. A variation in the air velocity over the surface affects both the air-to-air coefficient and the outside surface coefficient. The outside surface coefficients of brick and wood surfaces are affected in practically the same manner at the lower air velocities, while the coefficient for brick gradually rises above that of wood for the higher velocities.

3. The coefficient of transmission for a simple or compound wall, floor, or roof can be readily computed provided the surface coefficients for the building materials used in the surfaces are known for both still and moving air conditions. It is also necessary to know the coefficients of conductivity for all the materials used in the wall. These coefficients should be determined on full-size walls for the temperature range usually encountered. The effect of moving air is to increase the value of the outside surface coefficient, and this increase involves the combined action of heat transfer by radiation and convection.

4. The effect of the relative humidity of the air on the heat transmission of an ordinary building wall is so small that it can safely be neglected in determining the total heat loss from a building. An increase in the relative humidity of the air causes a slight increase in the value of the surface coefficient; hence the over-all transmission coefficient becomes larger. If the walls are actually wet so that they absorb moisture, the coefficient of conduction may be seriously affected, as in the case of brick work when an increase of at least 25 per cent. may easily occur.

5. Air space construction is of value at low temperatures, but not at high temperatures. In all cases the heat transmission across an air space will rapidly increase, not only with an increase in the temperature difference in the enclosing walls, but also with the same difference of temperature if the absolute values of the enclosing wall temperatures are increased.

Tackling the Halifax Reconstruction Problem

CHAIRMAN Rogers, of the Halifax Relief Commission, recently issued a statement with regard to the plans of the Commission and the problems confronting it. He states that there should be immediately rebuilt in Halifax nearly one thousand houses, but that the activities of the Commission have been delayed some weeks pending the passage of the act of incorporation by the local legislature. In order to relieve the situation as quickly as possible, the erection of modern, comfortable tenement houses is recommended. In addition, arrangements will be made by which those who owned their own homes in the devastated area will have an opportunity to select suitable designs and rebuild. Each individual will be consulted as to the style and type of house which may be within his reach on the basis of the value of his former home. It is pointed out that the work can be undertaken on a much lower basis under contract than if built by the individual owner. There will be no attempt, however, to control the wishes of the owner provided his plans are approved by the Commission's architect, and that the building regulations insisted upon for the benefit of the district and city are complied with.

With regard to schools, the Commission has not so far felt justified in assuming a large financial responsibility when it may be that the relief funds available will not be sufficient to meet all personal and private losses. In the meantime it has been taking such steps as it reasonably could to assist the situation. Churches will be aided as far as possible in order of, and proportionately to, their respective needs by credits and grants. They are advised, however, if possible to avoid building operations at the almost prohibitive costs of the present year, and those of the same denomination are also advised to unite with each other wherever practicable and thus avoid duplication of effort. Referring to the magnitude of the problem before the Commission, Chairman Rogers says, "Undertakings of this kind must not be launched without due consideration, but within a very short time we believe the work will be commenced and energetically pressed forward. It must be clear, however, that so great an undertaking cannot be accomplished in one season. The public will also understand how important it is that a large amount of work be carried on at one time, so that materials can be purchased more cheaply, and the houses—particularly those of the less expensive class—standardized, and money saved."

Stain to Cover the Discoloring Brick in a Wall

MANY fine residences have been given an unsightly appearance by the carelessness or lack of foresight on the part of the construction crew. A single barrow-load of brick that is lighter than the others, often finds its way into the front wall of the building. Although this troublesome item can be eliminated in the construction, yet it requires a good deal more supervision than the average construction receives if the best of results are to be obtained.

What we are concerned with to a large extent is how to remedy this trouble after the wall has been built. The following extract from the "Painters Magazine," in regard to stains, may prove of value:—

We have known of a red brick stain that was made by mixing bright Venetian red with water into a pulp, pressing it through a sieve to break up lumps that were formed in mixing and then adding enough stale ale or beer to make the stain of a proper consistency. To each gallon of this mixture was added one-quarter of a pound of calcined green copperas (iron sulphate) previously beaten up with a portion of the stain to a thin batter. This is the mordant or fixture without which the stain would finally wash off from the effects of rain. This calcined copperas is produced by heating green copperas in an unglazed earthen pot, thus driving off the combined water; under this process the copperas falls into a dry, whitish powder.

A more durable and permanent stain is made with Venetian red that has been ground in pure linseed oil in stout paste form or, if the stain is to be of a lighter shade, a mixture of Venetian red and French yellow ochre, both ground fine in linseed oil and beaten up with a small portion of a good turpentine japan to a smooth semi-paste, gradually adding in small quantities while stirring a mixture of one part (by measure) of 90 degs. benzol or good solvent coal tar naphtha and four parts (by measure) of turpentine until the proper consistency of stain is secured. Strain through cheesecloth and throw away the coarser particles as these would remain on the surface and be of no benefit in sealing the pores of the brick. An excess of oil in the stain is apt to produce " shiners."

Unsightly Efflorescence on Facing Brick

IT has been noticed that efflorescence is more pronounced under the copings, sills, belt courses, etc., or wherever a part of the building has been subjected to a greater wash by water. This indicates that the mortar, as well as the brick, is absorbent, causing the walls to become thoroughly soaked during the winter months, while the warm rays of the sun attract the moisture to the exterior, bringing with it the lime, magnesia, and alkali salts contained in both the brick and the cement mortar.

It is agreed by all interested in brick construction that both brick and cement mortar are absorbent, yet little has been done to overcome this objectionable, serious, and dangerous obstacle. Hydrated lime will add to the plasticity of the mortar, increase the density, and, being a water retainer, will add crystallization when used in places where it is difficult to apply water at frequent intervals. Tests have repeatedly shown that slabs containing 10 per cent hydrated lime, when taken out of the water after one hour, will contain a larger percentage of water than a similar sample of cement and sand, yet on the surface the lime sample is apparently bone dry.

A remedy for the above problem, now being tried out and which has withstood a test of over two years, is impervious cement mortar, to consist of (a) one part approved portland cement; (b) three parts sharp, clean sand, showing not over 35 per cent. voids by water; (c) 10 per cent. of weight of the cement of hydrated lime (sufficient to add to the plasticity of the mortar and retain enough water to perfect crystallization); (d) 2 per cent. of weight of the cement Medusa paste waterproofing. Each gallon (eight pounds) to be mixed with equal parts of water, later adding 20 more gallons. All mortar to be gauged with this solution.

If the sand is damp a one to fifteen solution should be used to offset the moisture already in the sand. All exterior brick and stone work to the depth of 12 inches should be embedded in this mortar. The extra cost of waterproofing the cement mortar will not exceed $1 per M. bricks, it is said.

Trial of Concrete Ship " Faith"

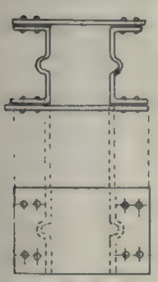
The smooth-water tests of the concrete ship "Faith," made in San Francisco Bay by the United States Shipping Board, were very satisfactory. In this trial trip the ship averaged more than the specified ten knots speed, under only 140 pounds of steam. Full steam pressure from the marine boilers and triple expansion 1,750 h.p. engines will be 165 pounds. Extensometer readings on deck and frames showed the vibration to be less, measured in the same way, than on similar steel vessels. The navigator reported that the "Faith" was handled more easily than a steel or wooden vessel of the same size and lines.

Bellefeuille & Trepanier, Ltd., Three Rivers, P.Q., has been formed to carry on the business of building contractors, including the construction of bridges, viaducts, dams, railways, and canals. The capital is $49,500.

A New System of Building Construction

A new system of steel-framed building construction has been introduced by a London (Eng.) firm. The system, which is on the multiple unit system, and is covered by patent, is illustrated herewith. The units employed consist of rectangular troughs of pressed steel, and they have a flange all round the periphery at right angles to the web. The square corners are formed during the pressing operation, and are, hence, weldless. One or more corrugations is, or are, pressed in the web with the object of adding greater stiffness without increasing the thickness of the metal. In addition to these trough-like units there are what are known as corner units. At the present time the trough or channel units are made in nine standard sizes. The first three are 6 ft., 5 ft., and 4 ft. long respectively, and all of them 8 in. wide and 2½ in. deep. The next three are also 6 ft., 5 ft. and 4 ft. long respectively, but they are 6 in. wide and 2½ in. deep. The third three are likewise 6 ft., 5 ft. and 4 ft. long, but they are only 4 ins. wide and 2 ins. deep. Holes of set sizes are bored in set positions in the flanges near and at the ends. The stock size of corner unit is, at present, 9 ins. on the vertical side and 9 ins. on the sloping side, while the side joining on to the trough units are made of a width to suit those units, and furnished with holes to match the holes in them. The angle of the stock corner units is made to suit a roof slope of 30 degs. They can, however, be made to suit other angles, or double to suit twin space.

SECTION A-A



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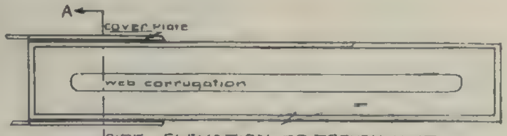
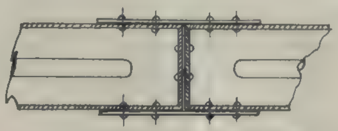
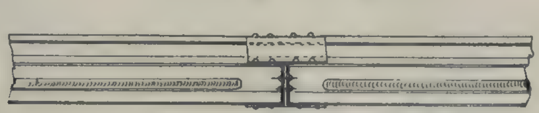


SIDE ELEVATION OF TROUGH UNIT



DETAIL OF CONNECTION



PERSPECTIVE OF BUILT UP SECTION

The object of erecting buildings on this principle is to aim at standardization and interchangeability of parts, and to make it possible to reduce the whole of a building into comparatively small, light and easily handled sections, so as to overcome the difficulty which is so often experienced when long, heavy and easily damaged parts of structures have to be transported by rail or ship to distant places, where facilities for handling are absent or inadequate. The inventors claim that with units such as these, erection at site is simplified, especially in cases where the joints are bolted and not riveted, for in such cases skilled labor is not required. The units are bolted together end to end by means of the end flanges, and the joints are further reinforced by means of cover plates bolted to the inner and outer flanges.

Except for large spans no trussing is used to support the rafters beyond a tie rod to take the outward thrust at the eaves, and a vertical suspension rod from the crown. For larger or smaller spans wider or narrower units may be employed.

The inventors point out that the units can be employed for the building up of towers, such as those used for supporting water tanks and other purposes. In such cases the sections or units are used for building up the stanchions or legs of the tower and also as horizontal members between the legs at each joint. In this manner the tower may be built upwards from the ground without heavy lifting tackle or staging. Among other directions in which it is claimed that the system may be employed is in the construction of bridges of small span and moderate loads.

Water Content the Most Important Factor in Making Concrete?

SOME revolutionary results have recently been obtained by tests carried out in the Structural Materials Research Laboratory of the Louis Institute, Chicago, regarding the part played by water in the making of concrete. In the recent past concrete has been looked upon as a mixture of cement, sand, and stone, with enough water merely to make it mix and place easily. The experiments recently carried out in the Louis Institute and described by Professor D. A. Abrams in a recent issue of Engineering News-Record show that the amount of water used in the mix is far and away the most important factor in the making of concrete. Some extracts from Professor Abrams' paper are given below:

Proportioning Water in Concrete Tests

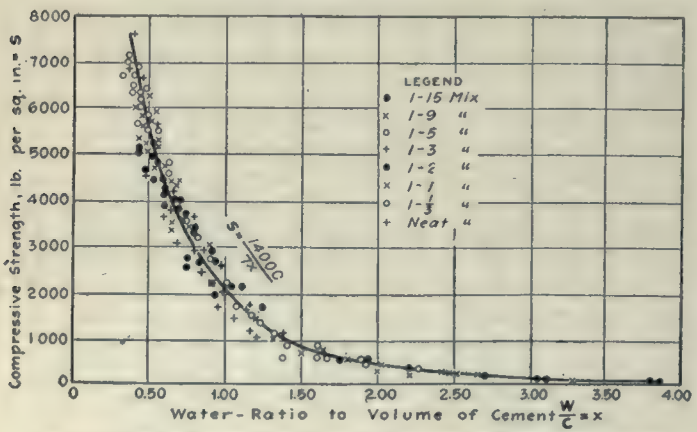
While the injurious effects of too much water in concrete is apparent, tests made in this laboratory show that the truly fundamental role played by water in concrete mixtures has been entirely overlooked in previous discussions of the subject. The relation referred to above is brought out by a series of compression tests of about 1,600 6 x 12-in. concrete cylinders, made up as follows:

Mix cement-aggregate.	Range of sizes of aggregates.	Consistency.
1:15		
1:9	0-14-mesh sieve	
1:5	0- 4-mesh sieve	Different consistencies for each mix and aggregate.
1:3	0-¾-in.	
1:2	0-1½-in.	
1:1	0-2-in.	
1:1/3		
Neat		

The mixes used covered a wide range, as did also the grading of aggregate and consistency. The aggregates consisted of two sizes of sand and mixtures of sand and pebbles graded to the sizes shown. The mix is expressed in terms of volumes of dry cement and aggregate, regardless of grading—i.e., a 1:5 mix is made up of 1 cu. ft. cement (1 sack) and 5 cu. ft. of aggregate as used, whether a sand or a coarse concrete mixture.

This series gives valuable information on the effect of changing the quantity of cement, the size of the aggregate and the quantity of water. The effect of many different combinations of these variables can be studied. One set of relations gives the effect of amount of cement-using aggregates of different size and grading; another set of relations gives the effect of different quantities of water, varying both mix and size of aggregate. In all respects the tests bear out the indications of earlier and later series, and reveal the true relation between the strength and the proportions of the constituent materials in concrete. The figure shows the relation betwen the compressive strength and the water content for the 28-day tests. The water content of the concrete has been expressed as a ratio of the volume of cement, considering that the cement weighs 94 pounds per cu. ft. Distinguishing marks are used for each mix, but no distinction is made between aggregates of different size or different consistencies.

When the compressive strength is plotted against the water in this way, a smooth curve is obtained, due to the overlapping of the points for different mixes. Values from dry concretes have been omitted. If these were used we should obtain a series of curves dropping downward and to the left from the curve shown. It is seen at once that the size and grading of the aggregate and the quantity of cement are no longer of any importance, except in so far as these factors influence the quantity of water required to produce a workable mix. This gives us an entirely new conception of the function of the constituent materials entering into a concrete mix, and is the most basic principle which has been discovered in our studies of concrete.



Lean and rich mixtures show striking similarity in strength variation for differing water contents.

The equation of the curve is of the form,

$$S = A/B^x \qquad (1)$$

where S is the compressive strength of concrete and x is the ratio of the volume of water to the volume of cement in the batch, A and B are constants whose values depend on the quality of the cement used, the age of the concrete, and curing conditions.

This equation expresses the law of strength of concrete so far as the proportions of materials are concerned. It is seen that for given concrete materials the strength depends on one factor only—the ratio of water to cement. Equations which have been proposed for this purpose contain terms which take into account such factors as quantity of cement, proportions of fine and coarse aggregate, voids in aggregate; but they have uniformly omitted the only item which is of any importance, the water.

The relation given above holds so long as the concrete is not too dry for maximum strength and the aggregate not too coarse for a given quantity of cement—in other words, so long as we have a workable mix.

For the conditions of these tests equation (1) becomes,

$$S = 14{,}000/7^x \qquad (2)$$

Other tests made in this laboratory have shown that the character of the aggregates makes little difference if it is clean and not structurally deficient. The absorption of the aggregate must be taken into account if comparison is being made of different aggregates.

In certain instances a 1:9 mix is as strong as a 1:2 mix, depending on the water content. The strength of the concrete responds to changes in water, regardless of the reason for these changes.

It should not be concluded that these tests indicate that lean mixes can be substituted for richer ones without limit. We are always limited by the necessity of using sufficient water to secure a workable mix. So in the case of the grading of aggregates. The workability of the mix will in all cases dictate the minimum quantity of water that can be used. The importance of the workability factor in concrete is therefore brought out in its true relation.

The reason a rich mix gives higher strength than a lean one is that a workable concrete can be produced by a quantity of water which gives a lower ratio of water to cement. If an excess of water is used we are simply wasting cement. Rich mixes and coarse, well-graded aggregates are necessary as ever, but we now know just how these factors affect the strength of the concrete.

Practical use may be made of the curve in estimating the relative strength of concretes in which the water content is different for any reason. For example, a concrete mixed with 7.5 gallons of water (1 cu. ft.) to one sack of cement (allowance being made for absorption of aggregate) gave a strength in this series of 2,100 pounds per square inch ($x = 1.00$). For $x = 0.80$ (6 gallons of water per sack of cement) we have 3,000 pounds per square inch; for $x = 0.75$ (5.6 gallons) 3,300 pounds per square inch. Concrete in a 1:4 mix (same as usual, 1:2:3 mix with a coarse sand) should be mixed with 5½ to 6 gallons of water per sack of cement.

The importance of any method of mixing, handling, placing and finishing concrete which will enable the work to be done with a minimum of water is at once apparent. It now seems that practically all faulty concrete work can be traced to the use of too much water.

These studies lead to many important conclusions with reference to such topics as tests of cement, tests of concrete containing admixtures, etc. Tests of cement from this viewpoint have been under way several weeks.

The annual report of the Department of Railways and Canals for the fiscal year from April 1, 1916, to March 31, 1917, has recently been issued. This publication contains the report of the Deputy Minister of Railways and Canals and five appendices which are as follows: Statements of the accountant of department; reports of the general manager and other officers of government railways; report of the chief engineer of the department; report of the government chief engineer for the Western Division of the National Transcontinental Railway; report of the Board of Engineers, Quebec Bridge.

Alberta Division, C. S. C. E., Holds General Meeting

A GENERAL meeting of the Alberta division of the Canadian Society of Civil Engineers was held in Edmonton on the afternoon and evening of April 27. The principal subjects discussed were proposed legislation defining the status of the engineer and the appointment of engineers to government commissions and offices.

Mr. F. H. Peters opened the discussion on the former subject. He reviewed the steps which had been taken in the Calgary and Edmonton branches in the discussion of this subject up to the present time. He stated that it now appeared that it would not be possible to secure Dominion legislation, and, in view of that condition, it was desirable to secure a provincial act which could be acceptable by all the provinces and afterwards, if necessary, affirmed by the Dominion Government, whereby it would provide for a uniform law all over the Dominion.

Mr. A. G. Dalzell, of Vancouver, was present, and described the feeling of the members of the society in British Columbia. He stated that when the matter was presented to the Vancouver branch some of the members claimed that legislation had been tried in two provinces and had been a failure. Objection had also been made on the ground that legislation meant a "closed shop," and the matter was further complicated because just at that time a certain group of engineers in British Columbia were asking for provincial legislation which had some objectionable features and which could not receive the support of the society. He believed, however, that legislation along the lines suggested by the Calgary branch was now receiving favorable consideration. The entire question was fully discussed by a number of the members, the result of the discussion being the appointment of a committee, consisting of F. H. Peters, W. Muir Edwards, and S. G. Porter, to further study the entire question, to draft a scheme of incorporation of engineers by provincial authority, and to report to the summer meeting at Saskatoon.

Mr. S. G. Porter, secretary of the Alberta division, opened the discussion on the question of the appointment of engineers on government commissions. He called attention to the importance of the engineers' work in bringing about the necessary readjustment of social conditions, due to the war, and to the engineer's claim for greater recognition in appointment to positions of public service. He outlined the efforts that the Alberta division had been making to advance the interests of the society in this respect. A letter was read from Professor Haultain, which called attention to the fact that the work of vocational training of returned soldiers had been placed almost entirely in the hands of engineers, by the Dominion Government. A resolution was adopted expressing the satisfaction of the members in this action. It was felt that it was particularly fitting that engineers, rather than men of any other profession, should have been placed in charge of this important work. J. L. Cote, M.P.P., was asked to speak on the Civil Service Act in Alberta. He explained that an Act had been passed by the provincial legislature providing for the appointment of an efficiency officer, but that the officer had not yet been named.

A dinner was given at the Macdonald Hotel, at which the members outside Edmonton were the guests of the Edmonton branch.

The meeting was well attended and much interest taken in all the subjects discussed. The following paragraphs are from Mr. Porter's paper:

The Appointment of Engineers to Government Commissions

In the "Literary Digest" for March 30, 1918, an article appeared which described some of the unfortunate conditions which have arisen in the United States, which it attributed to the employment of financial men instead of engineers to direct the production and transportation of war materials. As a result, it says a great deal of energy and enthusiasm and patriotic effort have been expended, without, however, having them properly co-ordinated, and now they find that there is an enormous congestion of materials in some lines, far in excess of requirements or shipping facilities, and a corresponding shortage in others. It claims, however, that the ability of the engineer to organize and direct war production with a proper regard for the necessary sequence and co-ordination of the various processes is being recognized, and that the engineer is coming into his own. Let us hope that it is true; true not only in the United States, but also in Canada.

It may be that engineers are largely to blame for conditions that now exist. Possibly they do not take the interest in public and political matters they should take; that they do not make themselves as well known as their importance in the community would justify. Is that the reason that among the four men considered by President Wilson for the important position of United States railway dictator no engineer's name appeared? Is that the reason that for such offices as minister of public works, or the head of a commission to report on the reconstruction of a destroyed city, or a commission to control the expenditure of public money on public utilities, our government seldom even gives thought to the idea of appointing engineers? Has not the engineer in this war demonstrated beyond dispute the importance of his profession and his right to proper recognition, not only in the prosecution of the war, but also in other government and public service?

I think we all realize that in the social readjustment which will follow the war—which, in fact, is in progress even now—the business of the world is going to be handled on a more scientific basis than before, with labor having more voice and capital less dictatorial power, with the engineer and other scientists directing their efforts and adjusting their differences. Governments are often slow to recognize changed conditions, even where the changes are radical, and it becomes one of our duties, both to ourselves and to our government, to interpret these social changes and insist that they be met in a businesslike way.

Another condition which must be recognized is that the government is assuming more and more the control and operation of the resources and utilities of the country. It should therefor have the best business and technical ability of the country in charge of them, instead of permitting professional politicians to blunder the job. Let us have more sound development and less exploitation.

In insisting that the government should appoint engineers to public commissions and offices we should insist, also, that they be good engineers, properly qualified for the work they are called upon to do; otherwise the end in view will be defeated and both the interest of the public and the prestige of the profession will suffer. It should be remembered that the duties of an engineer, particularly in public service, are often of a judicial character as well as technical, requiring sound judgment, based on thorough training and experience. Engineers, on their part, should be prepared to assume these responsibilities, while the government, on its part, should provide remuneration adequate for such service.

This phase of the question dovetails into the question of legislation for engineers. There is need of intelligent regulations to define a certain minimum standard in order to eliminate incompetents, create a high standard of service, and inspire public confidence. The public is entitled to a knowledge of the fitness and capability of the engineers it employs. By having a compulsory registry the government would be furnished with complete information relative to the special ability of every engineer in the country.

Manitoba Engineers Take Up Man-Power Problem

THE members of the Manitoba Branch of the Canadian Society of Civil Engineers, at a meeting held on April 22nd for the purpose of considering the urgent necessity of preliminary training for all young men and more especially for those likely to be called to the colors within one year, appointed a War Committee to take such measures as might be necessary for the following ends:—

1. To get an inventory of all engineers and technically trained men of any kind in the province, so that after ascertaining what material is available, preliminary training, both technical and physical, may be given in co-operation with the military authorities, so that the man-power of the province, whether trained technically for engineering work, or practising in various kinds of construction work, may be used to the best possible purpose in the present war.

2. The extreme seriousness of the events which have happened at the front since last March, demonstrates the necessity of sending forward the greatest number of men as quickly as possible. It cannot be too strongly insisted upon that these men must be physically fit. For, the experience of the past three years has shown that thousands of soldiers were rendered unfit, not only for war purposes, but for their former civil employments as well, because they had been taken from sedentary occupations, and owing to lack of time, thrown without judicious preliminary training into the intensive military service.

The members of the Manitoba Branch of the C. S. C. E., therefore, seriously suggest that immediate compulsory physical training be undergone by men, who are likely to be called to the colors within a year.

3. It would be wise, and indeed imperative, to prepare the man-power of this country on the assumption that this terrible war will last several years more, seeing that it is a fight to a finish. Consequently, it is our duty to have the growing generation properly prepared and trained for any future emergency, whether it be due to the prolongation of the war or to the economic struggle which is bound to come after the war.

The members of the Manitoba Branch of the C. S. C. E., therefore, strongly urge that compulsory physical training be given in all the universities, colleges and schools of Canada as far as practicable.

4. It is also imperative to prepare the technical power of this country in order to have the best possible class of officers in different army services. Consequently, it is a duty to have the students complete their classes and get their degrees before being called to the colors.

The members of the Manitoba Branch of the C. S. C. E., therefore, suggest that the universities and colleges continue the classes all the year round, as long as this war lasts, in order to allow the students to obtain their degrees before being called for service.

The War Committee of the Manitoba Branch of the C. S. C. E. relies on the patriotic spirit of all the members of your important Association to give effect to the above resolutions and to bring home to all the young men under their control or direction, or within the sphere of their influence, the supreme importance of training themselves, both technically and physically, for the great demands that are bound to be made on them in this great crisis, and after the war.

J. G. Legrand, Bridge Engineer, G.T.P. Ry.
D. T. Main, Works Manager, C. P. Ry.
Guy C. Dunn, Division Engineer, G. T. P. Ry.
G. L. Guy, Elect. Engr., Pub. Utilities Com.
(Convenor) Harold Edwards, Consulting Engineer.
War Committee, Manitoba Branch of the C.S.C.E.

A copy of the circular letter and of the questionnaire sent to the members of the Branch follows:

To the Members of the Manitoba Branch of the Canadian Society of Civil Engineers:—

In view of the recent serious developments in the war the Manitoba Branch of the Canadian Society of Civil Engineers, at a special meeting on April 22nd, appointed a committee on war affairs to promote in every possible way the co-operation of engineers and technical men with the military authorities in order that the engineering and construction man-power of the province may be used in the war with the utmost effectiveness.

1. The war is to be a LONG and EXHAUSTING one.

2. There is a great and increasing demand for trained engineers and technical men.

3. For any position in the service the man whose civilian experience will be particularly useful must be found and given effective preliminary training for the peculiar and special conditions of active service.

4. The right men for commissions must be discovered and helped along by special preliminary training.

5. Before the best system of training can be organized we must know what material we have in the province. The War Committee enjoins the earnest assistance of the members in order to make this inventory of the engineering man-power as complete as possible. THEREFORE, FILL IN THE ENCLOSED BLANK IMMEDIATELY.

6. In addition to filling out the enclosed blank the members should canvass their acquaintances, who have had engineering or construction experience and who are likely to be called in the near future. Knowing what the experience of the available men has been, preliminary training can be adapted to the needs of the greatest number.

7. We have reason to expect instruction from special instructors, who have seen active service in France, along the lines indicated on the inventory blank.

8. Remember that the man of 55 can be trained to do work that in many cases will set free the man of 30.

9. In view of our special training as engineers, it is our duty to strive to bring home to the minds of the people what this war really means, and how exceedingly serious and far-reaching its after-effects will be. We must not forget that the German Government had requisitioned every engineer, every chemist, every man in fact with technical experience of any kind in order to utilize their special knowledge for the successful prosecution of the war, and for the winning of the great industrial struggle which must inevitably follow in its wake. Canada expects every man to do his best in the great cause and this Branch of the Can-

adian Society of Civil Engineers proposes to help to work out the methods of preliminary training that will prepare engineers to do their utmost whenever they are called. THEREFORE, GIVE YOUR COUNTRY YOUR LEISURE AND ENTHUSIASM. . . . FILL OUT THIS BLANK AND GET OTHERS TO FILL ONE OUT ALSO.

J. G. Legrand, Bridge Engineer, G. T. P. Ry.
D. T. Main, Works Manager, C. P. Ry.
Guy C. Dunn, Elect. Engr., Public Utilities Com.
(Convenor) Harold Edwards, Consulting Engineer.
War Committee, Manitoba Branch C. S. C. E.

Questionairre

Name ... ... Birth Date ... ...
Married or Single ... ...
If married, number of children ... ...
Are you physically fit? ... ...
What military experience and training have you had?
In what lines have you had your best experience? Check off below:—

RAILWAY—Construction
  Operation
  Maintenance
  Shops and Rolling Stock
GENERAL BUILDING CONSTRUCTION
MINING AND QUARRYING
SURVEYING AND MAPPING
HIGHWAYS—Construction
  Maintenance
ELECTRICAL ENGINEERING—Power and Lighting
  Wireless
  Telegraphy
  Telephony
AUTOMOBLIES AND MOTOR TRANSPORTS—
  Driving
  Repair
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300 Tribune Building,
Winnipeg, Man.

Winnipeg, Man., April 30th, 1918.

Concrete Shipbuilding

FURTHER valuable information on the subject of concrete ships was given to the Northwest Coast Institution of Engineers and Shipbuilders, at Newcastle-on-Tyne, in a paper read by Mr. T. I. Gueritte, councillor of the French Board of Trade. Extracts from this paper follow:—

"In the construction of a large number of 250 horsepower tugs now being built in France, the author was able to satisfy himself that two weeks were sufficient to erect the moulds (for repeat tugs the erection of the first mould took somewhat longer) and place the steel in position. The process of concreting was occasionally carried out in 48 hours. All told, it is safe to say that in normal working the yard referred to completes a hull in three weeks. The tugs take water broadside on, and an average of three weeks is allowed for maturing. With the restricted amount of labor at present available, the said yard can turn out one of these tugs every week, but from explanations given to the author by the yard's manager it is certain that two tugs could be completed every week in normal times. In another place the author has seen in what was four months before a bare field, two 1,000 ton deadweight barges ready for launching, and several others following closely. Barges of that kind, or again, the hulls of small cargo steamers of 1,000 tons deadweight, may easily be turned out and launched at the rate of one every ten weeks from each slip in a well organized yard."

Speed of Construction

"It will be understood that from 3 to 5 weeks have to be added to allow for the maturing of the concrete. In ordinary land work one considers generally that a test load may be imposed upon a new floor 5 or 6 weeks after its completion. But the concrete used in that case is not so rich in cement as for ships, and the richer the concrete the quicker the required strength is attained. It might be possible to utilize that period for partly fitting up the ship instead of waiting until she is afloat, so that the maturing period would not be lost altogether."

Making Repairs

"Such local damage as may occur in ferro-concrete ships will be most easily repaired, the hole being blocked up by providing a small timber shuttering and filling the hole with new concrete, after having added, if need be, a few strengthening bars. By using a very rich mixture of concrete, the patch will be able to stand the water pressure in a couple of days or even less, and if need be, one may not remove the shuttering before putting to sea again, for further safety. Such a repair may even be carried out under water. Cementing or concreting repairs to quay walls or jetties under water are by no means processes unknown to civil engineers.

"In December last the author had the good fortune (if he may put it that way) to inspect a 1,000-ton barge which a couple of days previously had suffered damage during a faulty launching; it had been repaired as explained above, and was then afloat and in excellent condition. Several instances of damage to river or canal barges in use abroad have been recorded, all pointing to the same conclusion, and all investigators seem agreed that repairs to ferro-concrete ships will be quicker and much cheaper than to steel vessels. Alterations to the design in course of erection, or while the ship is in service, are quite easy.

Cost of Concrete Ships

"The saving which can be effected by ferro-concrete in a certain class of vessel is due partly to the saving in steel, partly to the fact that no heavy plant is required for ferro-concrete work, and partly to the fact that the bulk of the labor employed need not be skilled, and is therefor cheaper. But if the last two factors remain the same whatever the size of the vessel, the first is a variable one. To start with it must be stated that the saving in steel is not as great as was wildly claimed at first by superficial designers who had not grasped the difficulties of the problem, a saving of 80 per cent. or even more as has been mentioned occasionally, seems quite out of the question. Nevertheless, the saving exists, and in some cases exceeds 50 or 55 per cent., which is not at all negligible. And in that respect it is as well when comparing figures to note that in ferro-concrete there is no waste of steel in the process of construction, whereas it seems a recognized fact that the weight of steel required for building a steel ship is about 10 per cent. greater than that of the steel which is finally embodied in the structure, owing to waste in cuts of plates, angles, rivet bolts, etc."

Ste. Anne de Bellevue Filtration System

Mechanical Gravity Units Employed in Conjunction with Coagulant Treatment

A MECHANICAL gravity filtration plant, designed by Messrs. Ouimet & LeSage, Montreal, is being constructed in the town of St. Anne de Bellevue, P.Q. The contract for the work is let to Messrs. Arsenault & Plamondon, Ltd., Montreal, who are acting in conjunction with the Atlas Construction Company, Montreal, the equipment being supplied by the Roberts Filter Manufacturing Company, Darby, Pa.

The plant consists of two filter units, of a capacity of 725,000 U. S. gallons per day each unit covering 126 square feet; a clear water basin of 50,000 U.S. gallons, and a coagulation basin of 82,000 U.S. gallons, together with pumping room. All these are contained in one building, 69 x 31 feet. The superstructure of the building is of plastic and rustic brick, with a Barrett specification roof. The remainder of the work is of reinforced concrete, made of a 1:2:4 mixture.

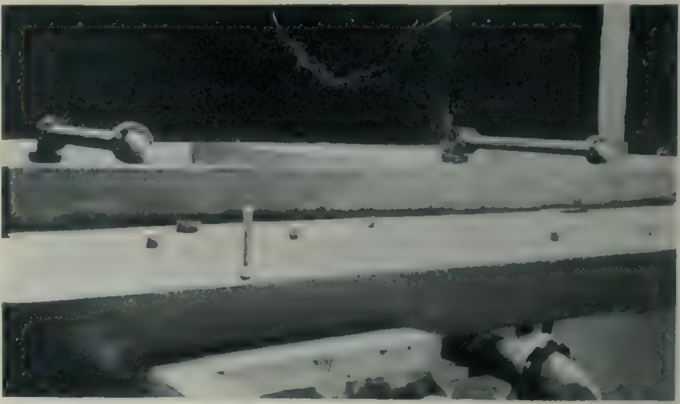
Owing to the rock formation a large amount of blasting was necessary, the near vicinity of houses compelling considerable care in this work. The area blasted was 70 x 25 ft., of an average depth of 5 ft.

The water is taken from the Ottawa River, there being in existence an old pumping plant, which up to the present has supplied raw water to the town, and which is being utilized as part of the present scheme. In it are located the high lift pumps.

The filter building is a one-storey structure, with the filters, clear water basin, pumps, etc, at one end, and the coagulation basin at the other. The clear water basin is beneath the filters, the ground being excavated to a depth of 10 feet. The pipe gallery is situated on the roof of the clear water basin, while the operating gallery is reached from the filter floor by a short stairway. The pumping room is on the same level as the filtration units, and contains two low lift pumps, one electrically driven and the other gasoline driven. The pumps have a capacity of 500 U.S. gallons per minute against a working head of 30 feet. The motors are of the squirrel-cage induction type, of 550 v., 3-phase, 60-cycle. The blower for supplying air under pressure for washing the dirty water is driven by an electric motor.

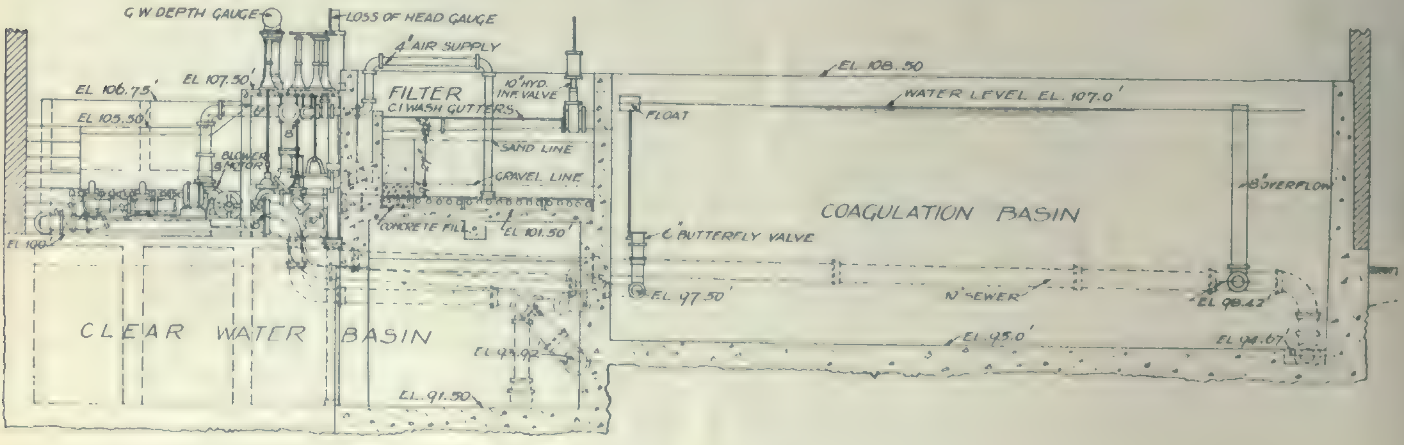
Each filter unit is equipped with a filtered water manifold and strainer system, the strainers being of the interior orifice type, for washing the filters at the rate of 9 U.S. gallons per square foot of filter surface per minute, or for delivering air at the rate of 4 cubic feet per square foot per minute. The strainers are of brass and bronze. The filters are provided with water wash gutters for removing the dirty wash water and for distributing the raw water over the filter surface during filtration. The gutters are of cast-iron, the top edges being placed 13¾ in. above the sand line.

The gravel is laid to a depth of 9 in., in three layers, and the sand to a depth of 27 in.; the latter material is to have, according to the specifications, an effective size of not less than .35 m.m., and not more than .055 m.m., and a uniformity coefficient of not more than 1.7. The combined depth of gravel and sand is not to be less than 35 in.

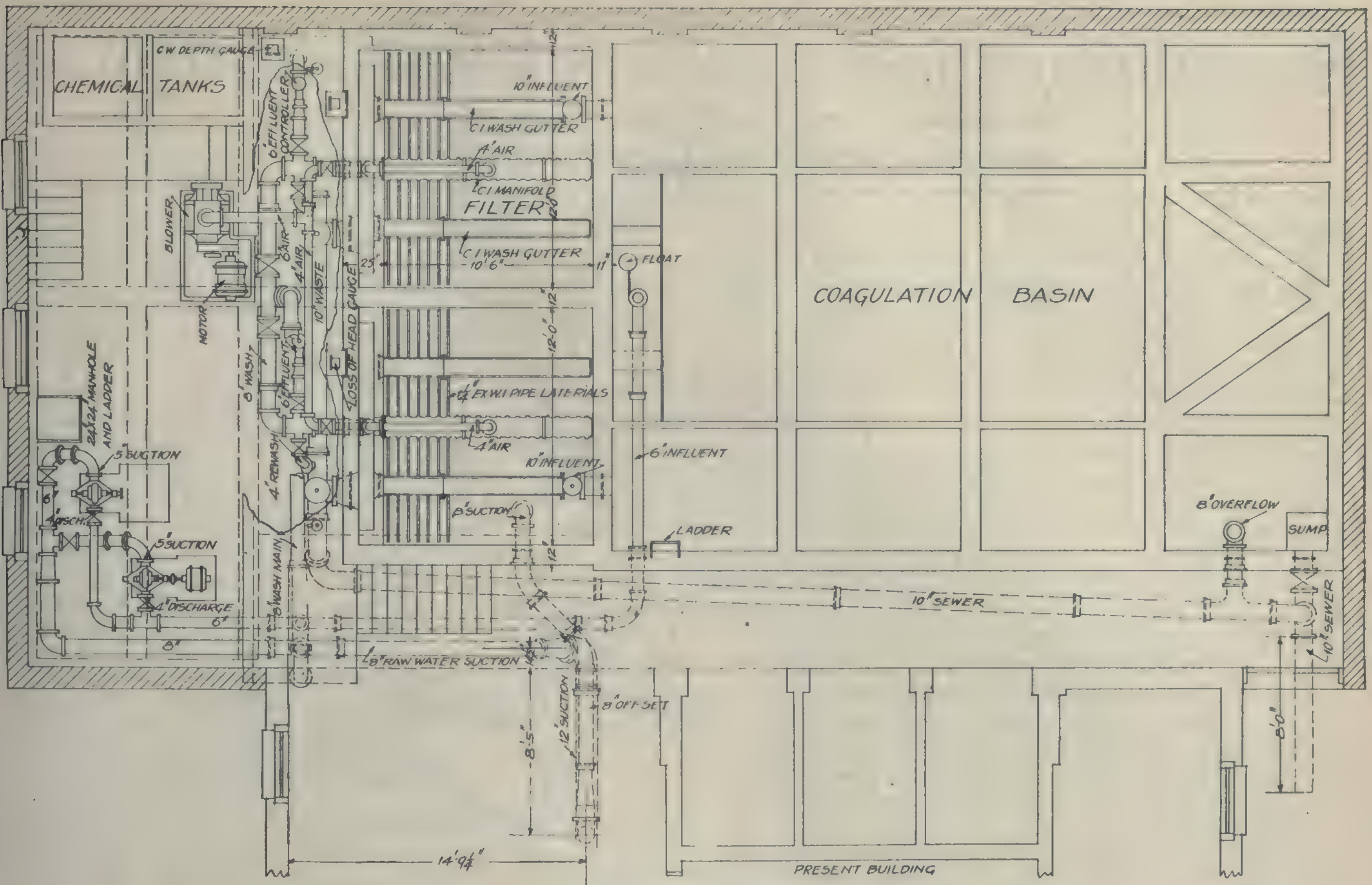


In front of filter beds.

The filters are provided with the usual rate controllers, valves, loss of head gauges, and depth gauges. All valves for the operation of the filters are hand-operated. The influent valves are provided with hydraulic cylinders. The effluent automatic rate-controllers have a normal capacity of 362,000 gallons per 24 hours, but



Longitudinal cross-section.



Plan of general layout.

are adjustable so as to charge up to 450,000 gallons per 24 hours.

The raw water suction line is connected with an existing 12 in. plugged suction elbow, and extends to the suction ends of the low lift pumps, while the main raw water line commences at the discharge ends of the low lift pumps and goes to the inlet chamber of the coagulation basin, where it is controlled by a float-operated water level valve of the butterfly type. The wash water line extends from a connection with an existing 8 in. force main under the old pumping room to the two wash water filter valves in front of the filters. The main drain runs from the filter waste valves and rewash connection in front of the filters to the drain line to the river at the rear of the existing pumping house, the main drain having branches connecting with an 8 in. overflow and 10 in. blow-off installed in the coagulation basin.

Entrance to the clear water basin is by a cast-iron manhole.

Two concrete tanks, with apparatus for feeding the coagulant to the pump suction line, are provided. The agitators are operated by a horizontal water motor.

The coagulant tanks were treated with creosote oil and two coats of Barrett waterproofing paint. A Wallace & Tiernan liquid chlorine apparatus, with connection to the raw water suction and clear water suction pipes, is installed in the pumping room.

Two Galt, Ont., industries will make considerable additions to their plant this season. One is the Galt Brass Company, which proposes an extension of 114 x 164 feet, and the other is the R. McDougall Company, which will erect a three-storey addition, 120 x 64 feet.

Members of Ottawa Branch, C. S. C. E., Visit New Pumping Station

On Saturday, May 18, through the courtesy of Mr. J. B. McRae, M.Can.Soc.C.E., and by invitation of the Mayor and Board of Control, the members of the Ottawa branch of the Canadian Society of Civil Engineers were given the opportunity of visiting the new pump house at Lemieux Island and seeing it in operation under different loads. The event combined social pleasure with technical interest, as the members were invited to bring their friends, including ladies, and tea was served afterwards.

A hydro-electric plant for the College de Montfort, P.Q., is to be rebuilt, the contract having been let to Messrs. Arsenault & Plamondon, Limited, Montreal. A concrete dam 10 ft. by 12 ft., is to be constructed at the entrance to a small lake, a wood stave pipe line, 3 ft. in diameter inside measurement, conveying the water to a power house, of brick and concrete, 25 ft. by 15 ft. The water wheel will be of 150 h.p., and will be manufactured by the William Hamilton Company, Limited, Peterborough, Ont. The power will be used for lighting the college, sawing wood, and for laundry purposes. The water is to be pumped for domestic use and for fire fighting purposes. Arthur Surveyer & Company, Montreal, are the consulting engineers, the electrical work—a portion of which is already done—being carried out by E. Lionais, Montreal.

Negotiations are proceeding for the formation of a branch at Hamilton of the Canadian Society of Civil Engineers.

Special Car Plant for Lining Railroad Tunnel

Combines Compactness and Ease of Handling Materials—Run of 201 Cubic Yards in One Day

THE following method of lining a railroad tunnel, used by the Carolina, Clinchfield and Ohio Railroad, was described by Mr. H. B. Kirkland in a paper presented before the Western Society of Engineers. This car plant was used in lining the 7,804-foot single track Sandy Ridge tunnel near Dante, Va.

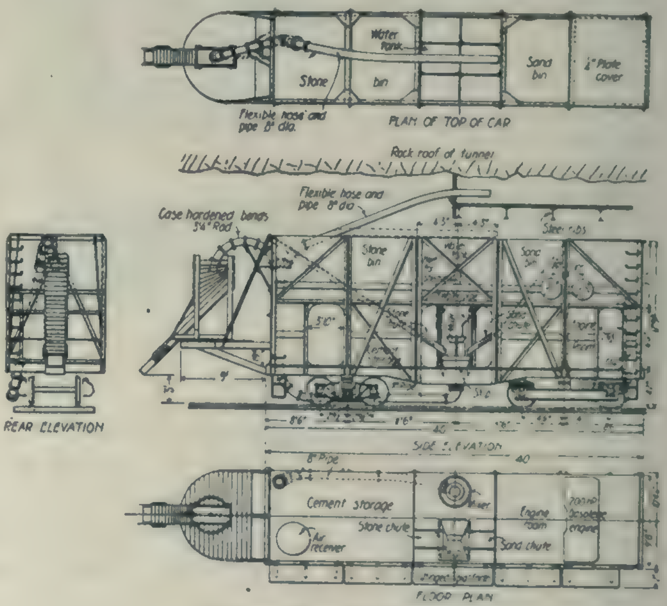
The car is 40 ft. long, 10 ft. 4½ in. wide near the braces and 17 ft. 9 in. from top of rail to top of car. It has a central chamber open on the sides, 8½ ft. long, 9 ft. 8 in. wide and 10 ft. 3 in. high, in which on one side is located the pneumatic concrete mixer and on the other side the charging skip. Over this chamber is a water tank of 1,850 gal. capacity, which furnishes water for the concrete and is also connected with the cooling system for the gasoline engine. On one end of the car, facing the central chamber, is a stone bin of 30 cubic yards capacity. Each bin has a chute 20 inches wide leading to the charging skip and each chute is controlled by an under-cut gate. Under the stone bin is a space occupied by a 96-cubic foot receiver, standing vertically, and the storage of the cement in bags.

Under the sand bin is the gasoline engine and its auxiliary equipment, completely housed from water and dust. The charging skip in its lower position stands with its top rim about 1 ft. 3 in. above the floor and travels on inclined guide rails to its upper position over the mixer, being hoisted by a compressed air cylinder 9¼ inches in diameter. The gate of the skip works automatically by means of a guide rail. The mixer is for a 2-bag batch (0.4 cu. yd.) and has an 8-inch outlet pipe at the bottom running horizontally and curving to the outside of the rear truck and thence vertically to near the top of the car, where it branches by means of a wye into two lines, one a 180 deg. bend to the rear for "shooting" into foundations and sidewalks, and the other going to the roof for "shooting" into the arch. The wye is a special device with a sliding plate controlling the movement of material into either arm. The arrangement of the pipe, traveling with the car and being in position at all times for "shooting" concrete, results in a material saving of time and expense.

Along one side of the car, level with the main floors, is a folding platform 2 ft. wide used by the men carrying cement and to gain access to the engine room. During the ordinary work of the car this platform remains down. The arrangement is compact and arranged with a view to save manual labor. One man controls the hoisting of the skip, the injection of water and the mixing and discharge of the batch. One man is placed at each chute and two men carry, open and empty the cement bags.

The gasoline engine is of the 6-cylinder, 4-cycle tee-head type and is rated 200 h.p. at 350 r.p.m. It can be throttled to 125 r.p.m. The motor and its frame constitute one of the trucks of the car. The cylinders stand in a row at right angles to the track and the whole construction is compact but accessible. The engine is started by admitting compressed air into three cylinders, then the explosion of the gasoline takes place in the other cylinders and continues the motion. The transmission is by means of a Morse chain on the driven axle (one only being used) and the control is through a friction clutch of special design.

The loading and storage trestle is so arranged that the concrete car goes under it and receives crusher-run stone, sand, bag cement and water by gravity. The sand and stone is drawn from overhead bins by means of under-cut gates. Cement is conveyed into the car by a chute. The trestle has a track over its deck upon which stone and sand in hopper cars are stored or unloaded into the bins below. There is a continuous row of 27 bins with an aggregate capacity of 324 cubic yards and a total length of 162 feet, and 5 loaded cars can be stored over these bins to give an additional storage capacity of 200 cubic yards.

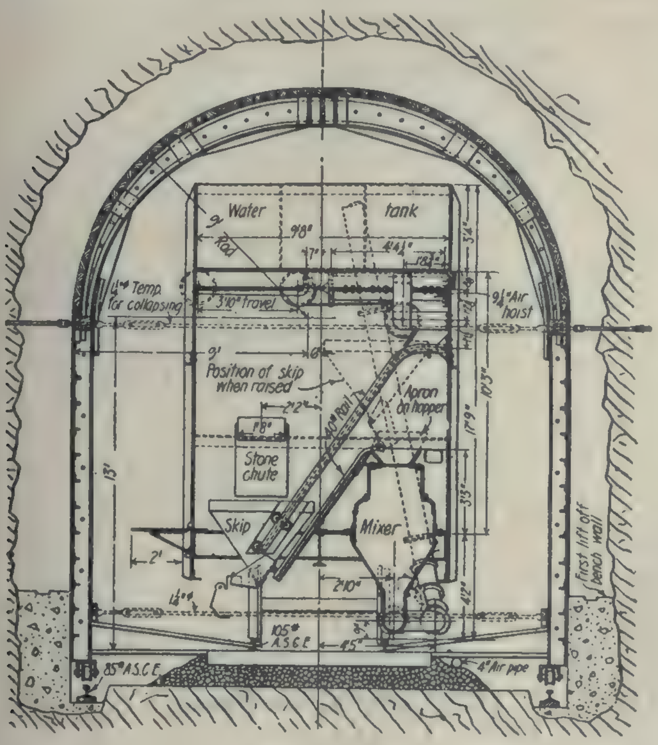


Plan and elevation of car plant.

The compressor plant was exceptional for a temporary outfit. To save money on foundations and at the same time to increase the space, the floor level of the boiler and compressors was fixed 4½ ft. above sub-grade, the concrete foundations and walls were built up to this height and the cellular space underneath was utilized for water tanks and ash pit. The building was built of 1-inch boards covered with tar paper. The arrangement chosen permitted coal to be dumped from cars on the trestle to a pile in front of the boilers. There were two boilers, both locomotive type, one new one of 150 h.p., and one old one of 70 h.p. The piping connections were such that either one could be cut in or out of service for cleaning or repairs. Two compressors are installed, but an extra foundation for another unit was provided, for reasons which appear elsewhere. The compressors were alike, a high speed, single stage type with a steam cylinder 12 in. by 12 in., an air cylinder 12 in.

by 14 in., a piston displacement at 250 r.p.m. equal to 528 cubic feet, an actual output of about 375 cubic feet of free air per minute each. This worked under 125 lbs. steam pressure and compressed air at 115 lbs. They were cooled by water brought by gravity from the mouth of an old coal mine. From the compressors a 6-inch pipe leads to a 150 cubic foot air receiver, from which a 4-inch pipe line led on a steady 0.5 per cent. down grade entirely through the tunnel. At the lower end was a pet cock to draw off any water. In order to provide for expansion and contraction, the pipe line was laid alternately on the east and west sides of the track in lengths of about 1,000 feet, connected by curves of 2 feet radius. The bottom of the pipe was at the level of the bottom of the ties and 1 foot out from their end. About every 100 feet a long radius tee was placed and about 20 mine cocks of 4-inch size were provided; these could be shifted to the various tees as the progress of the work demanded. From the mine cock a 3-inch hose 60 feet long connects with the 96-cubic foot air receiver on the car which can thus be connected to the 4-inch pipe line from any position in the tunnel.

Several runs of 180 cubic yards per day and one run of 201 cubic yards were made. The work consisted of putting in the foundation and the initial lift of bench wall 4 feet 4 inches high, which involved moving the car more than was necessary when "shooting" into the arch form.



CROSS SECTION THRU' TUNNEL AND CAR.

Another feature of this plant is the short pipe through which the charge moved. The pipe is 41 ft. long to the chute on the front of the car and the mixture is good, using a ½-yard machine. The difficult problem on a car like this is to design the plant so as to charge the mixer fast enough to work to its capacity. The mixer can shoot a batch every 15 seconds if enough air is furnished and the charges can be placed in the machine fast enough. The time records on the work of this car are as follows:

Aug. 17, 1915, 423 batches in 381 min., av. 54.0 sec. per batch.
Aug. 18, 1915, 323 batches in 302 min., av. 56.1 sec. per batch.
Aug. 19, 1915, 448 batches in 340 min., av. 45.5 sec. per batch.
Aug. 20, 1915, 325 batches in 250 min., av. 46.1 sec. per batch.
Aug. 21, 1915, 309 batches in 309 min., av. 54.3 sec. per batch.

The variation is due to the condition of the material, whether wet or dry, which affects the rapidity with which it flows in the chutes and skip. It is believed that the operation can be speeded up to an average of about 35 to 40 seconds per batch with dry material.

Montreal Civic Commissioners Have Difficult Problems to Handle

The Montreal civic commissioners are proving a stronger board than was at first anticipated. Some of the appointments were political and nearly all the members were without municipal experience. The appointment of Mr. R. A. Ross, however, ensures that the city will have a commissioner who commands the confidence of Canadian engineers. Montreal affairs are admittedly in bad shape, and it will require a considerable period to put them on anything like a satisfactory basis.

The old commissioners did not work in unison; one member made himself particularly disagreeable to his colleagues, with whom he differed on almost every subject. The members of the new board are pulling better together, and are endeavoring to organize the various departments on a more businesslike foundation. The members are not afraid of antagonizing certain sections of the public by imposing additional taxes in order to make up deficits in the revenue, and they have defended their proposals against strong criticisms by the council.

The result of spendthrift expenditure in the past is seen in the disrepair of the streets, which have been allowed to get into bad condition owing to lack of funds. The city is not in a position to undertake at present public works to any appreciable extent, as there is a lack of money, and the commisioners are not inclined to attempt to borrow, and so add to an already very heavy debt. There are two or three matters, however, which will soon have to be faced, such as a new pumping station, a further water supply, and the much-discussed aqueduct. Money can no doubt be saved by cutting down the civic staff, but it will entail some careful financing if funds are to be found to meet requirements which are certain to become pressing in a very short time.

Following up the preliminary decision to reorganize the departments, the commissioners have named the heads of the four sections under which the work of the city, outside finance, will be grouped. Mr. Paul Mercier is in control of the public works; Senator David, secretary's department; Chief Tremblay, public safety, and Dr. S. Boucher, public health. This arrangement is expected to result in the elimination of a considerable amount of overlapping and in the reduction of the staff.

The revised plans and specifications of the government office building, Ottawa, have been issued, and tenders are to be in by May 27. The first bids were too high, and the government decided to revise the plans, with a view to lower costs.

A gang of men has started work on repairs to the harbor at Glace Bay, N.S. Daniel McDonald, of Cottage Lane, has the contract.

Design and Construction of Brick Pavements

MODERN brick pavements are of two general types: monolithic and composite. A monolithic brick pavement, as the name signifies, consists of a single rigid beam. Depth of beam is beside the point. The monolith may be a single course of grouted brick laid on natural soil, or it may comprise two or three strata of different materials united in a solid beam unit.

Pavements Without Artificial Foundations

In many sections of the South, where frost action is negligible, and in several Northern cities as well, the monolithic beam is formed of a grouted brick surfacing only, the brick being laid on compacted natural soil. Where the soil compacts firmly and frost action is not troublesome, this type of construction can be relied upon to give satisfaction, with ordinary heavy traffic. Even in some Northern cities, in which the soil is gravelly or sandy, pavements laid without artificial foundations have given acceptable service for many years. Cleveland, Ohio, has more than 30 miles of such pavement, and continues to lay some of it each year on natural soil foundation.

The Cement-Sand Bed

In many sections, especially in the Southern States, where frost upheavals are rare, the use of a 1-inch cement-sand bed under the brick, and the use of a 3½-inch brick, is becoming the prevailing type of construction. No longitudinal cracks appear in brick pavements in the South.

This type of construction has been used to some extent on state highways in Illinois, and on the Lincoln Highway in Indiana, and experience has demonstrated its value in resurfacing macadam roads with brick.

The 1 inch of cement-sand bed spread over compacted natural soil or macadam serves as a bedding course for the brick. It prevents the soil from working up into the joints when the brick are rolled, and, after it sets up, it protects the pavement against water which may invade the sub-grade. Unlike a sand cushion, the cement-sand bed does not shift or settle in spots.

Concrete Foundation

In sections where severe winters are the rule, or where heavy trucking, in the modern sense, may be expected, a monolithic pavement usually is constructed with a concrete foundation either 4 or 6 inches in depth. Generally speaking, a 4-inch brick is used for surfacing, but excellent results have been obtained with a 3½ or a 3-inch brick of a type affording exceptional bonding strength. Three-inch and even 2-inch concrete foundations have proven entirely satisfactory in some sections, notably in the South and in Illinois.

Local conditions of soil, climate and traffic should determine the depth of foundation specified.

Two Methods of Constructing Monolithic Brick Pavements

There are two methods of constructing monolithic brick pavements, although for convenience in distinguishing the method, rather than as a means of differentiating types of pavement, these methods are often misleading referred to respectively as monolithic and semi-monolithic, or as green-concrete and cement-sand bed construction.

The two methods achieve practically the same result. With the first method the brick are laid on a green concrete foundation—if any foundation is used—either with or without a ⅛-inch film of cement-sand spread over the green concrete, in order to compensate the slight inequalities of surface which sometimes occur, unless extreme care is exercised in preparing the surface of the base.

With the second method a cement-sand mortar bed, usually in proportions of 1 to 4, thoroughly mixed in a mechanical mixer, is spread dry, not to exceed 1 inch in depth, over a cured concrete foundation, and the brick are laid on this bed and are grouted.

Theoretically, the cement-sand bed is converted into a mortar by wetting down the brick just before the grouting is done. The mortar bed effects a practicable union between the brick surfacing and the concrete foundation, and it assures an even bearing for the brick and a stable beam.

Either method necessitates shaping the surface of the concrete foundation as nearly as possible to a true contour and cross-section of the proposed surface of the finished pavement, and at the correct depth below the designed surface. In every case in which the cement-sand bed is used it is regarded as 1 inch of the foundation; that is to say, if a 4-inch foundation is designed, 1 inch of the 4 inches is cement-sand bed. No cross-expansion joints are used on monolithic pavements, but on city streets where curbs are used, longitudinal expansion joints are placed alongside the curb to the depth of the foundation.

Green concrete construction was originally designed for highways especially, although it is adapted to streets as well. Cement-sand bed construction is more easily handled on wide streets, since a cured foundation is used; but it is fully as serviceable on highways and it is frequently so used.

Neither method requires flush side-edgings on highways. Earth or gravel shoulders give ample protection to the edges of the pavement.

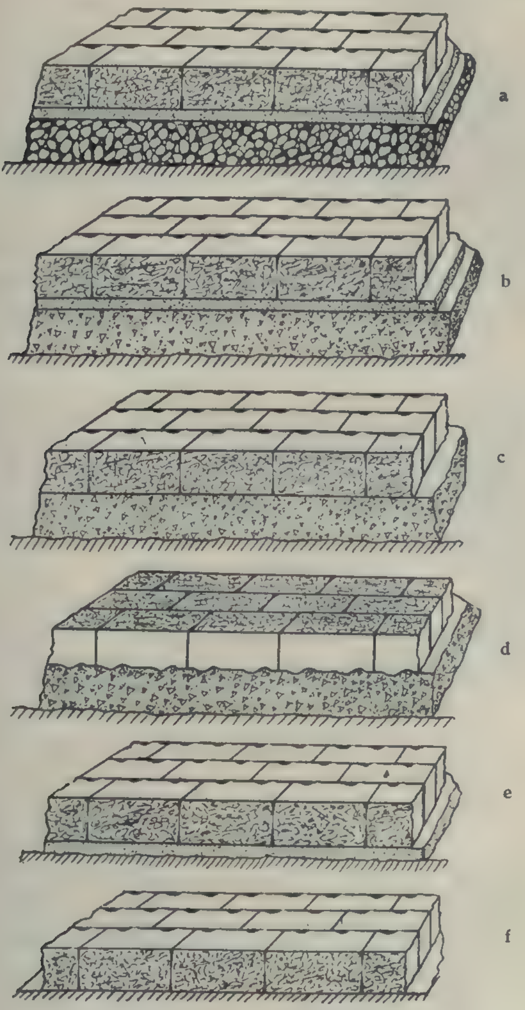
Composite Pavements

Composite brick pavements are those in which unusual combinations of materials are used. Of these are brick pavements with bituminous filler and bituminous-bound foundation, or with bituminous-bound foundation, cement-sand bed and cement-grout filler.

A wire-cut lug brick pavement may be laid with the lugs down in green concrete and the rough, wire-cut side uppermost. Over this roughened surface a carpet of some bituminous preparation may be spread.

Vertical Fibre Method

This method of construction is known as the vertical fibre method, because traffic passes over what is theoretically assumed to be the ends of the structural strata of the brick instead of the strata running theoretically horizontal to the plane of traffic. Of course, no good paving brick has a pronounced stratified interior structure, and no brick has a fibrous formation. Shale or clay is ground fine, it is mixed thoroughly and the constituent particles are closely compacted, practically uniformly, by the augur machine and, in a good brick, they are vitrified in a virtually homogeneous mass of practically uniform density. The assumption, however, that good paving brick are noticeably stratified and that the brick set in one way present vertical stratification has given rise to the term vertical fibre. As a matter of fact, the term vertical fibre applies to a method of construction rather than to any structural characteristic of the brick itself. If a paving brick shows any appearance of stratification it is due to laminations, which are recognized as imperfections.



(a) Wire-cut lug brick—Bituminous bound foundation, bituminous or cement filler. (b) Wire-cut lug brick—Cement-sand and conrcete foundation, cement or bituminous filler. (c) Wire-cut lug brick—Green concrete foundation, cement or bituminous filler. (d) Wire-cut lug brick—Vertical fibre type, bituminous or concrete filler. The wire-cut lugs embedded in the concrete foundation. (e) Wire-cut lug brick—Cement-sand foundation, cement filler. (f) Wire-cut lug brick—Natural soil foundation, cement filler.

Monolithic brick pavements possess several advantages over other types, whichever method of construction is employed. It has a greater strength per inch of depth, thereby rendering it feasible to reduce the depth of foundation without sacrificing required load-bearing strength or durability. It is practically noiseless; it averts weather hazards during construction; it eliminates side edgings; it obviates defects arising from material coming up into the joints and preventing the bonding material from penetrating to the bottom of the joints; it overcomes shifting or shrinking of the bedding course, and—a feature of the utmost importance just now—it economizes time in construction.

Speedy Construction

In these times of highway transportation of domestic commodities and war supplies, speedy construction of durable highways is of prime importance.

Where a green concrete base is used, brick pavements can be built rapidly if the contractor has adequate equipment and an efficient organization. All constructional processes go on simultaneously. That is to say, the preparing of the green concrete base and the laying, rolling, inspecting and grouting of the brick are all being done at the same time within a distance of 50 lineal feet, so that at the end of each working period the pavement is finished as far as any work at all has been done, excepting the preliminary grading and the placing of temporary side forms.

Output Per Day

As no side edgings are required for highways, it is not uncommon for an organization of 25 men, aided by good mechanical equipment, to build 700 square yards to 800 square yards of monolithic brick pavement, with a 4-inch concrete base, in ten hours. One contractor is reported to have built 1,000 square yards of monolithic pavement in a working day, using mechanical conveyors for delivering the brick to the pavers; but the writer does not know the numerical strength of that contractor's organization.

The foregoing figures represent possible achievements rather than reasonable expectancy. Nevertheless, concentration of constructive energy within a small area, the elimination of periods of waiting for one portion of the work to set up before another step can be taken, the absence of weather hazards and the omitting of side edgings all combine to expedite construction.

When the sand cushion was used, a rainfall after the brick were laid, but before rolling, necessitated taking up the brick, re-preparing the sand cushion and relaying the brick; but rain does not damage green concrete foundations or cement-sand beds after the brick are laid.

Organization of Forces

Contractors are important factors in war-time construction in which the saving of time without detriment to good work is important. Contractors differ in their ideas of the number and distribution of men required in an organization. Local conditions often determine the arrangement. From 25 to 30 men is the rule for monolithic construction.

Generally speaking, a contractor's organization large enough to construct from 500 square yards to 700 square yards of monolithic highway in a 10-hour day is made up as follows:

Two men, form setting; 8 men, concrete mixer; 1 man, finishing concrete surface; 2 men, dropping brick; 12 men, carrying brick 2 men, culling and rolling; 4 men, grouting.

Tarvia—The Barrett Company have isued an interesting booklet, entitled "Tarvia—Preserves Roads—Prevents Dust," with a number of illustrations of good roads resulting from an application of this product. The same company are distributing a booklet written by William S. Mannix, entitled "The Avenue of Sublime Peace." This is descriptive of the first modern highway in China, which was made possible by Tarvia.

Safety in Scaffolding Construction

Regulations Adopted by Pennsylvania Department of Labor and Industry as to Materials and Methods of Erection

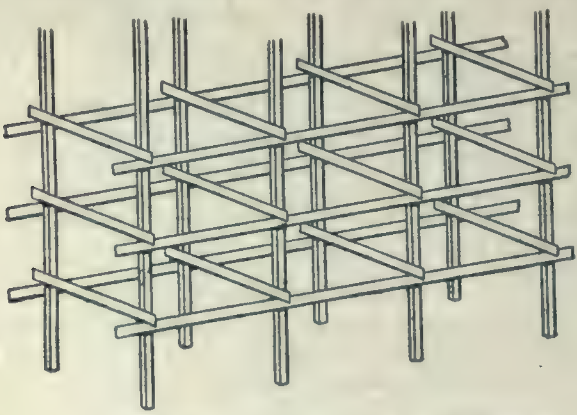
IN order to guard against accident due to the improper methods of erecting scaffolding on building construction work, the Industrial Board, Pennsylvania Department of Labor and Industry, have adopted the following rules and regulations, referring in particular to scaffolds erected for brick walls:

No person shall be permitted to labor in any group employment, in a position of command or obedience, who is unable to speak or understand the language of his or her co-laborers, whereby through misunderstanding, accident, and injury are apt to result to fellow-workers.

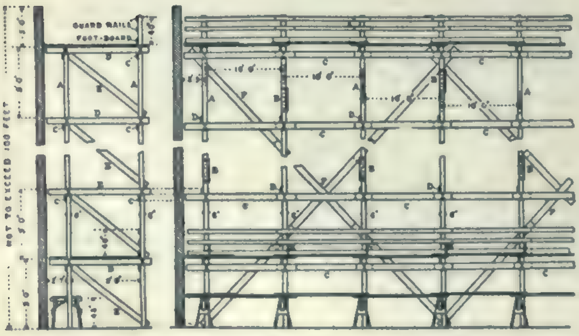
The Scaffold Poles

For ordinary pole-scaffold work on buildings not more than five storeys in height, the poles or uprights should be 3 x 6 inches in cross-section and shall not be less than 3 x 4 inches. For extra heavy work, or for buildings more than five storeys in height, the size of the poles shall be correspondingly increased at the bottom, and gradually taper off to a minimum of 3 x 4 inches at the top. The poles or uprights shall be as near to the wall as practicable. For ordinary work they should be set so that there is a clear space of 5 feet between them and the wall.

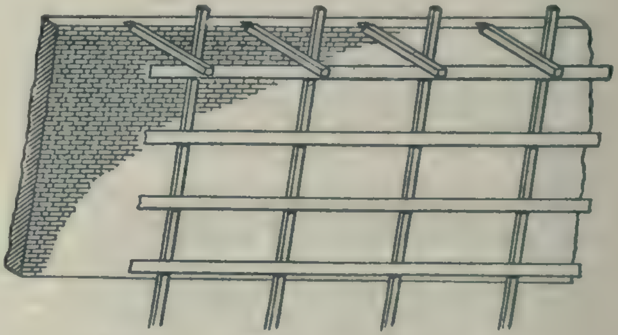
In standard construction the poles shall be spaced parallel to the wall, at a distance of not more than 7 feet 6 inches from centre to centre (16 foot platform planks being then used). Where the scaffold turns a corner the poles shall be set closer together. The uprights of a pole scaffold should never be allowed to rest directly upon the surface of the ground. They shall be securely fixed at their lower ends, to prevent displacement. Where the ground is hard and stony, a hole 8 or 10 inches deep should be dug, and the end of pole should be brought firmly against the undisturbed earth at the bottom. The removed soil should then be filled in around the foot of the pole and be solidly rammed.



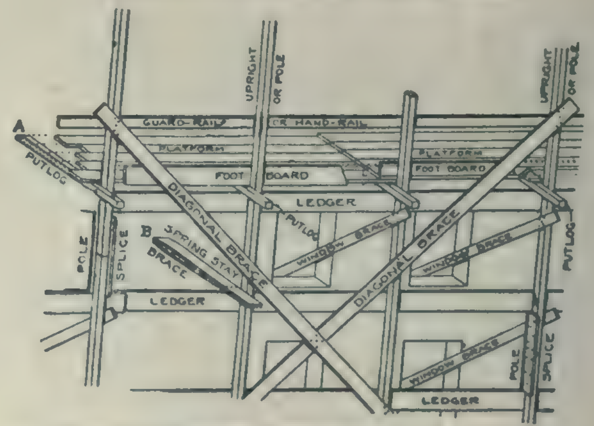
Skeleton of an Independent Pole Scaffold..



Design for an Independent Pole Scaffold for Construction Work.



Skeleton of a Bricklayers' Pole Scaffold.



General Scheme of Bricklayers' Pole Scaffold.

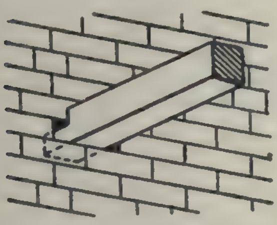
Where the ground is soft, a sound block, about a foot square and not less than 2 inches thick, should be placed at the bottom of the hole to distribute the load. The pole shall be solidly fastened to the centre of the block, either by nailing or by some other effective means. Where a pole bears directly on a sidewalk or other thoroughfare the foot shall be rigidly fixed so as to prevent its sliding or otherwise becoming displaced. To increase the height of an upright, except where a bolted scarf is used, the upper pole shall be set squarely upon the end of the lower one, and should be fastened to it by means of cleats securely nailed to both poles. These cleats should be not less than 1 inch thick by 4 feet long and not less than the width of the pole. They should be so placed as to overlap each pole by not less than 2 feet. Not less than two cleats shall be used to every joint or splice. Two or more consecutive or contiguous uprights should not be spliced at the same general level.

The Ledgers

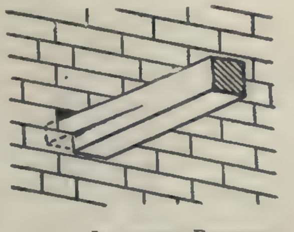
Ledgers shall be not less than 1 inch thick (or 7/8 inch thick if surfaced on one side). For heavy work, ledgers should be 12 inches wide. Where the load on the platform is sure to be light, ledgers may be only 10 inches wide; but ledgers less than 10 inches shall not be used.

When poles are set at the standard interval of 7 feet 6 inches between centres the ledgers should be at least 16 feet long and overlap the poles by a few inches at each end. Ledgers which have become split at the ends shall not be used.

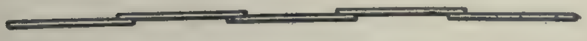
The vertical spacing of the ledgers is best determined by the requirements of the work being carried on. For bricklaying purposes the height from the upper edge of one ledger to the upper edge of the one next above should be approximately 5 feet. Care should be taken to see that the ledgers are level, and that their top edges are at the same height as the bottom of the openings in the wall opposite them for receiving the ends of the putlogs; and wherever possible all ledgers shall be nailed or otherwise fastened to the inside of the poles or uprights. Unless clamps or through-bolts are used, nothing less than ten-penny 3-inch nails shall be used for nailing ledgers. Where practicable, not less than five such nails shall be used. Where two ledgers lap over each other on the same pole, each ledger shall be subject to these minimum requirements.



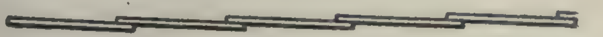
Correct Position of Putlog.



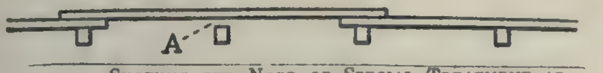
Incorrect Position of Putlog.



Usual Arrangement of the Platform Planks.



Another Method of Laying the Planks.



Showing the Need of Special Treatment at Certain Points.

For heavy platform loading the ledgers should be reinforced with cleats nailed to the poles at the bottom of the ledgers, and for ordinary loads, putlogs shall be not less than 3 x 4 inches.

Putlogs should be long enough to project over the ledgers by not less than 6 inches, and in new work the ends of the putlogs should be built into the wall, and shall not be notched or cut down.

The Platform Plank and Putlogs

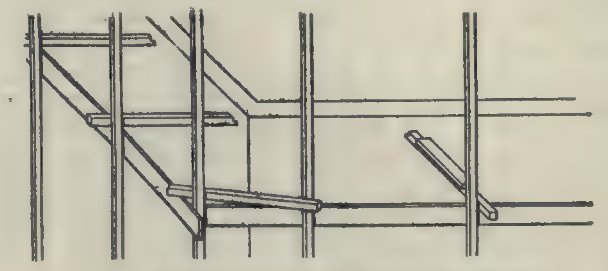
In alterations and repair work, where the putlog is notched or cut down at the end, so as to enter the hole left in the wall by the removal of a brick, the notch shall always be on the upper side of the putlog. The notch should be just deep enough to permit the end of the putlog to enter the hole in the wall, and shall be not more than 5 inches in length. The putlogs shall not have less than 4 inches bearing on the wall, and where a putlog comes at a window opening it shall be rigidly secured to prevent displacement.

Putlogs shall be spaced not more than 4 feet apart, and care shall be taken to place the putlogs so that they rest upon the ledgers as close as possible to the poles.

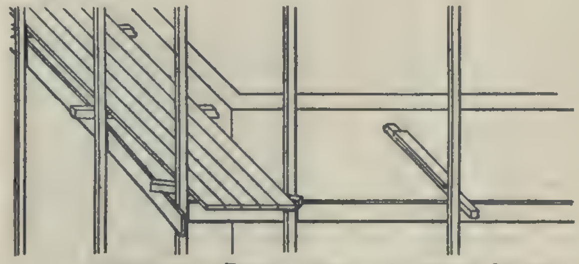
Platform planks shall not be less than 1 inch thick, and should not be less than 10 inches wide. They shall be laid with their edges close together, so that the platform will be "tight."

Two successive lengths of planking shall not be permitted to abut upon a single putlog. If planks are laid end to end, two parallel putlogs shall be provided not more than 8 inches apart, and in such manner that one putlog supports the end of one of the planks and the other putlog supports the abutting end of the other plank. Where platform planks overlap on a single putlog the lap of both upper and lower planks shall not be less than 6 inches over the centre of the putlog.

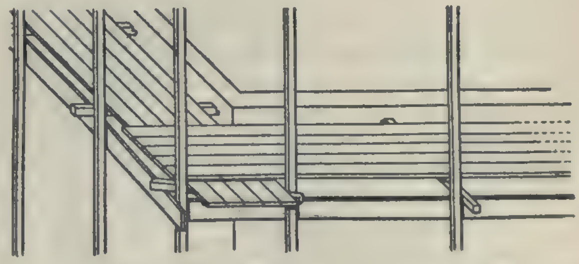
Platform planks shall project over putlogs at end of scaffolds by not less than 6 inches, and by not more than 12 inches, unless a rail is provided, to prevent a man from walking out on the unsupported end of the plank.



Showing the Corner Putlog in Position.



Showing the First Course of Planks in Position.



Showing Both Courses of Planking in Position.

Bearing Surface and Bracing

Where the scaffold turns a corner one or two putlogs should be laid diagonally across the corner, so that each may have one of its ends resting upon each of the two ledgers that meet at the corner, and great care shall be taken in laying the platform planks where the scaffold turns a corner, in order to eliminate all danger from tipping.

All pole scaffolds shall be thoroughly and adequately braced and shored in such a manner as to prevent same from swinging away from the building, and from collapsing by moving parallel to the wall of the building.

Promoting Road Maintenance in Manitoba

THIS year, as usual, the Manitoba Good Roads Association is active in its efforts to stimulate interest in the good roads' movement. Its endeavors are directed towards getting the municipalities of the province to do as much as possible in the maintenance of roads, which, especially under present conditions, is most important. The split-log drag competition, which in past years has obtained excellent results, is again being carried on this year. The Association's rules covering this annual competition have been printed in the Contract Record on a previous occasion. Four prizes, of $50, $30, $20 and $10, respectively, are offered by the Association to individuals keeping the best two miles of road in each class of the competition, and a number of special prizes will also be donated. In addition, the provincial government will award trophies for the best maintained stretch of road in the province, in each of the classes—these to remain in the possession of the winning municipalities for a period of one year. The conditions in regard to this award provide that the judges in the local dragging competition districts shall make an inspection of the roads in their respective districts during the week preceding September 1st and the roads adjudged to be the best maintained in these districts at that time shall be eligible for final competition for provincial trophies. The names of the successful competitors are then to be forwarded to the Highway Commissioner not later than September 7, and the judges for the provincial trophies shall make their selection for the awarding of the trophies from the sections of roads thus submitted. It is provided that the person maintaining the road which has won a provincial trophy shall receive a miniature of such trophy, which shall remain in his sole possession, and he shall also receive a cheque for $25—such miniature and cheque being in addition to any prize which may be won in a local competition district.

Aside from the awarding of these trophies, the Provincial Department of Public Works also encourages the proper maintenance of roads by a grant of $3.25 per mile of road dragged during the entire season in any municipality, subject to certain conditions. The proposals for the season of 1918 are as follows:

1. That an instructor be appointed for the whole period during which the work of dragging the roads is being performed, and that the salary and expenses of such instructor be borne by the government.

2. That a grant be made by the government of $3.25 per mile of road entered in a properly organized system and dragged during the entire season in any municipality, and that such grant be paid the municipality on the statement of the secretary-treasurer thereof, certified to by an official of the Department of Public Works that the roads included in such statement have been part of a system regularly organized, and that said roads have been continually dragged during the season.

3. That the amount to be paid any one municipality under these proposals shall not exceed the sum of $250, notwithstanding the fact that the number of miles of roads dragged in such municipality may be more than the mileage necessary to entitle the municipality to receive said amount on the basis of grant per mile above mentioned.

Providing the following regulations are observed by the municipality:—(a) That the dragging of the roads continue for the entire season or at least between May 1st and October 31st. (b) That a dragging district consisting of one or more municipalities be formed under proper organization before such district be entitled to the above grant. (c) That all roads entered in a system be first graded to the satisfaction of the instructor. (d) That each district in which a competition is being held arrange for the judging of the roads in its own competition. (e) That the Council of the municipality forward to the Highway Commissioner, Department of Public Works, before May 1st next, a list of the roads to be dragged in its system. (f) That the Council furnish the Department of Public Works with such information relative to the cost of dragging the roads as is required on the forms prepared for this purpose by the Highway Commissioner and forwarded to the secretary-treasurer of the municipality.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

City	April 1918	April 1917	April, 1918, compared with April, 1917 Increase (*) Decrease (†) Amount	Per cent
Nova Scotia	**$ 328,103**	**$ 108,850**	***$219,253**	***201.42**
Halifax	306,850	70,935	* 235,915	*332.58
Sydney	21,253	37,915	† 16,662	† 43.95
New Brunswick	**47,925**	**44,145**	*** 3,780**	*** 8.56**
Moncton	12,550	19,645	† 7,095	† 36.12
St. John	35,375	24,500	* 10,875	* 44.39
Quebec	**808,729**	**880,903**	**† 72,174**	**† 8.19**
Montreal Maisonneuve	648,510	631,340	* 17,170	* 2.72
Quebec	109,044	219,798	† 110,754	† 50.39
Sherbrooke	2,300	20,200	† 17,900	† 88.61
Three Rivers	48,875	7,465	* 41,410	*554.72
Westmount	......	2,100	† 2,100	.....
Ontario	**1,226,278**	**1,802,907**	**† 576,634**	**† 31.98**
Brantford	24,830	13,430	* 11,400	* 84.88
Fort William	5,940	114,475	† 108,535	† 94.81
Guelph	26,310	19,995	* 6,315	* 53.43
Hamilton	232,120	366,340	† 134,220	† 36.64
Kingston	40,849	32,443	* 8,406	* 25.91
Kitchener	12,620	76,497	† 63,877	† 83.53
London	85,200	84,290	* 970	* 1.15
Ottawa	40,706	141,150	† 100,444	† 71.16
Peterborougs	12,760	18,910	† 6,150	† 32.52
Port Arthur	10,216	109,813	† 99,597	† 90.70
Stratford	12,655	32,250	† 19,595	† 60.76
St. Catharines	53,990	21,317	* 32,673	*153.27
St. Thomas	6,355	8,605	† 2,250	† 26.15
Toronto	570,532	594,652	† 24,120	† 4.06
Windsor	91,130	168,740	† 77,610	† 45.99
Manitoba	**133,575**	**160,065**	*** 23,510**	*** 12.81**
Brandon	9,675	11,715	† 2,040	† 17.41
Winnipeg	173,900	148,350	* 25,550	* 17.22
Saskatchewan	**154,525**	**96,845**	*** 57,680**	*** 59.56**
Moose Jaw	30,130	53,270	† 23,140	† 43.44
Regina	29,310	36,000	† 6,690	† 18.58
Saskatoon	95,085	7,575	* 87,510	*1,155.25
Alberta	**72,175**	**41,650**	*** 30,525**	*** 73.29**
Calgary	56,400	33,700	* 22,700	* 67.36
Edmonton	15,775	7,950	* 7,825	* 98.43
British Columbia	**184,480**	**96,594**	*** 87,886**	*** 90.98**
New Westminster ...	13,350	3,565	* 9,785	*274.47
Vancouver	163,230	73,824	* 89,406	* 12.11
Victoria	7,900	19,205	† 11,305	† 58.86
Total (35 cities) ...	**$3,005,785**	**$3,231,959**	**†$226,174**	**† 6.99**

For April of this year there were 108 permits granted for dwellings, to cost $259,680, while for the same month last year the number was 59 and the value $171,200. During the first four months of this year 167 permits were issued for dwellings at a value of $459,480, as compared with 207, valued at $504,225 for the corresponding period in 1917.

Regulating the Height of Buildings*

Disadvantages of Skyscrapers — Exclude Sunlight and Increase Street Congestion

SKYSCRAPERS do not always denote the greatest civic development of our cities. It is common knowledge that men who are continually confined in dark prisons, grow anaemic, and even die, although otherwise well cared for, and it is also a well-known fact that Arctic explorers who have experienced the long winter night of the polar regions grow haggard, morose and quite abnormal under this condition, all of which symptoms disappear with the return of the sun. Can we expect to have a strong and progressive race of people when thousands of them are compelled to leave their homes before the sun is fairly up, take a long ride in a street car, worse still, perhaps through a subway, and work all day in a room where the sun never shines, a room ventilated by courts?

In the time of the Roman Empire there was a very long litigation between the Emperor of Constantinople and a resident of that city back in the third or fourth century, A.D., when Constantinople was made the eastern capital of the Empire. The real estate speculators arrived there promptly and began to make money by booming land values. The Emperor picked out a very beautiful site for his palace, on a hill which overlooked the water. This fellow picked out a piece of ground which was in front of the Emperor's proposed palace, and he erected a building of stone and brick five or six storeys high, then built about four storeys of wooden structure on top of that. The Building Commissioner of that time ordered him to take the wooden part off, but he refused and hired a good lawyer, and it took ten years for the Emperor to get the top pulled off that building, this fellow insisting that it was simply temporary, to be used by workmen while completing the building below it, and he got by with it for ten years.

They had buildings in Jerusalem 100 feet high. In Rome they had plenty of high buildings, and they had a peculiar type of high buildings there, each storey projecting out a little beyond the storey below it, until on the narrower streets, many of which were only ten to twelve feet wide, the buildings actually met at the roof line, so that people could travel across the top of the buildings. And as they went up the storeys grew lower until the top storeys were only five or six feet high.

Probably the greatest evil resulting from high buildings is that of street congestion. The high building houses thousands of people, nearly all of whom enter and leave the building about the same time daily. To come from their homes, which are scattered in all directions, they require street cars, automobiles or other vehicles, which as they converge to one point, create serious congestion on roadways, as well as sidewalks. For example, a building housing 1,000 people calls for the use of 12 or 15 street cars to carry the occupants, and these cars would fill the car tracks for an ordinary city block. It must be remembered that for each 1,000 fixed users of a building, there must be several hundred transients to be reckoned with. If one large building has so pronounced an effect upon street congestion, what must be the result when we reach the point where we have entire city blocks so improved.

A traffic count in New York shows us the startling effect of congestion. On Fifth Avenue at Forty-second Street, from 8.30 a.m. to 6.30 p.m., a period of ten hours, during which time there passed 18,800 vehicles and 137,780 pedestrains, and for the same hours counts taken at ten points on Fifth Avenue, ranging from Fourteenth Street to Fifty-ninth Street inclusive, showed an average of 14,096 vehicles and 82,506 pedestrians. We think of a city having a population of 137,000 as a real town, yet here we have a condition where all the people of a large city pass one point on one street in a period of ten hours, and a mass of vehicles, which, allowing 20 feet to each one, would make a procession 71 miles long, also passing at the same time. Such vast numbers are more than we can fully realize, and should be of themselves sufficient comment.

Manifestly, with such crowds in the street, there must be serious congestion within the buildings themselves, some of which house as many as 3,500 people, to which, if we add the transients, we can safely estimate that more than 4,000 persons are in the building at any moment for a number of hours each day. Four times daily these persons must enter or leave the building in a comparatively short space of time, which must create an elevator congestion that is both serious and dangerous.

Let us consider some of the results of the street and building congestion:

Obviously, the wear on the street pavement must be very severe, and the cost of maintaining good streets under such a concentrated heavy traffic is of necessity high. The problem of street building, to stand up under heavy traffic in the cities is a serious one as every engineer knows. There must also be present a large amount of dirt, dust and other debris, which when blown by the wind is injurious to goods, buildings, furnishings and health. Estimates have been made from time to time of the property loss due to smoke and dirt in cities, and the most conservative of these estimates are very large amounts. The noise and confusion resulting from so vast a throng of moving people and vehicles is very great, and according to the medical authorities, produces a noticeably injurious effect on the health of those who are constantly a part of it.

There are many problems of transportation, both of humans and produce which are created by this congestion.

The collecting and concentrating of such great numbers of people into a small area and distributing them to their homes again daily, brings street, street car, terminals, shelter and other problems of great magnitude and difficulty. The raw material which they use, and the finished product which is produced from them, together with the appliances and power used in the processes, and the feeding of those so engaged, creates problems of transportation and handling of goods, which are large and complicated.

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*Extracts from a paper by V. D. Allen, before the Cleveland Engineering Society.

Besides the congestion above the surface, there is a serious congestion beneath the surface of the streets, for the presence of many large buildings requires an increase in the sewers, water lines and conduits, and other ground service, as well as the constant tearing up of the already over-crowded street surfaces to renew or repair the underground work. Investigation shows that as congestion of traffic on streets increases, the number of accidents increase in about the same, or perhaps in an accelerating ratio, and of necessity the number of men employed as traffic officers must be increased, which is another cost that the city as a whole must pay that we may have high buildings.

Another effect of congestion is the problem of the feeding of this vast throng of people at the noon hour. There can be no doubt that this shows itself in lower health since thousands must eat in a hurry, food which is poorly cooked, and under conditions which are not congenial, and after their meal there is no chance for the relaxation or the recreation which they need.

The loss of sunlight at the street surface and to the surrounding buildings is in itself an evil of sufficient magnitude to condemn high buildings. I shall give you some figures developed by the engineers of the New York Commission. They apply with equal force to Cleveland, since we are in about the same latitude as New York. They base their figures on the shortest day of the year, which is December 21 at noon, and find that the Adams Express Company Building, which is 424 feet high, casts a shadow 875 feet long. The Equitable Building, which is 493 feet long, casts a shadow 1,018 feet long. The Singer tower, which is 546 feet, casts a shadow 1,127 feet long, and the Woolworth tower, which is 791 feet high, casts a shadow 1,635 feet long.

Cutting off the sunlight from the street produces a damp and dreary effect, alike depressing and unsanitary, but while the loss of sunlight at the street surface is bad, the effect of cutting off sunlight on the occupants of the buildings is a more serious evil.

Under the same condition, that is, at noon, December 21, at a north and south street, and having buildings on both sides of the street, one and thirty-five hundredths times the width of the street in height, it is claimed that all the windows get some direct sunlight, but if the buildings were increased to one and one-half times the width of the street in height, then but 90 per cent. of the windows will get direct sunlight, and as the height of the buildings are increased the amount of windows getting direct sunlight decreases rapidly until when we have buildings six times the width of the street in height, the percentage of windows which receive direct light is reduced to 22½.

Not only this, but under the same condition a window which has a building on the opposite side of the street one time the width of the street above it, has direct sunlight entering it but 12 per cent. of the time that the light would enter an unobstructed window. This loss of sunlight reacts unfavorably on the general health of the occupants of the building and since it is necessary to use artificial light all the time, the strain on the eyes of the persons in such buildings is severe and results in many forms of human ills, which of course, decreases the efficiency of these persons as producers.

There is also the cost and maintenance of light and the inferior product resulting to be added to the economic wastes chargeable to high buildings. The air in the streets, courts and yards which are flanked by high buildings into which but little direct sunlight can shine is, according to the best authorities, injurious to health, since the sun's rays have the power of purifying the air as nothing else can.

In the modern high tenements we have another class of evils due to abnormal domestic conditions, and when those who toil in the high commercial building, as is frequently the case, are compelled to live in high tenements, it seems to me we have created a condition of life which is doubly destructive to the progress of the human race.

Students of high buildings have placed much emphasis on the fire hazard created by these buildings, and while it is an important feature and should be considered, it is in my judgment not so important an objection to them as has generally been contended. It is true that the fire departments cannot reach a fire which is more than 80 or 90 feet above the street except by the use of a stand pipe, but the danger from fires in office buildings is very small and can be almost eliminated by the use of fireproof material in their construction and the proper protection of wall and vertical openings by fireproof windows and doors.

The financial side of this question deserves a word. The testimony given before the New York Commission demonstrated that the skyscraper was not a good paying investment. While it is true that one such building standing alone will pay, since it can get its light and air from the surrounding property, yet when other buildings are around it and it has lost this advantage, then its renting value decrease accordingly. In the last analysis, high buildings beget high land values, land values which are speculative in nature, and it remains to be proven that such land values are a benefit to the community.

New Book

Handbook of Hydraulics—by Horace Williams King, professor of hydraulic engineering, University of Michigan; McGraw-Hill Book Company, Inc., New York, publishers. This book is intended primarily to assist in the solution of hydraulic problems. The author has kept in mind the twofold purpose of securing accuracy consistent with the best experiments and of simplifying calculations. A large portion of the book is given over to tables. A knowledge of the fundamental principles of hydraulics is presupposed, and derivations have been omitted except where they appear necessary in explaining new methods. The older and commonly accepted formulae are given preference over the new, except where there would be a distinct gain in accuracy or simplicity. The author departs from standard American practice in advocating the use of the Manning formula in place of the Kutter formula. New weir formulae are also submitted. Exponential formulae are advocated for pipes, and a simplified method of using them is given. The book is designed for practising engineers and advanced students; 425 pages, flexible cover; approximate size, 4 x 7 inches.

The Eastern Flexible Conduit Company, of Brooklyn, N.Y., announce a change in name to Eastern Tube and Tool Company, Inc., because of the fact that they have added a line of drill chucks and small tools. They will continue to manufacture metallis and non-metallic conduit and armored cable.

Are Lightning Rods a Protection Against Fire?

A PAPER compiled by R. S. Whiting, architectural engineer, and published by the National Lumber Manufacturers' Association, contains suggestions regarding the value of lightning rods. Statistics show that in the United States the annual property loss due to lightning is about $8,000,000, while the average number of persons struck by lightning is 1,500. Mr. Whiting states that lightning rods reduce the fire hazard 80 to 90 per cent. in the case of houses and 99 per cent. in the case of barns. Any style or system of lightning rods is better than none at all, but in order to procure the highest degree of efficiency standard rods should be used.

The Metals Used

The metals used consist of copper and iron. The iron should be galvanized to prevent rust; the rods may be painted.

Air terminals should be located at all high points and projections, and the distance between the points along ridges and parapets should not exceed 25 ft. Down rods should be run in such a manner that the discharge on any one terminal may have two or more paths from the base of terminal to the ground where practicable. As straight a run as possible should be provided for the down rods, and the fasteners should be spaced not more than 5 ft. apart and be of the same material as the rods. They should be securely fastened in place, suitable allowance being made for expansion. Three ground terminals must be provided where the required number of air terminals is more than six, but not more than twelve.

Too much stress cannot be laid on the necessity of properly installing ground terminals, as they are the means by which electric contact is made between the lightning rod and the earth.

Buildings and Tanks

In the case of a two-gable house the ground terminals are placed to good advantage at diagonally opposite corners, one terminal being placed where the rain-spout discharges.

Regarding the lightning equipment for water-towers, the height of the structure determines the size of the conductor. Only one air terminal is required, located and properly supported at the highest point of the roof. Tanks higher than 60 ft. should have at least two ground terminals, while steel tanks supported on steel trestles need be provided only with ground terminals, properly bonded to the bottom of the trestle.

The expense of installing a standard lighting system becomes a matter of little consequence as compared with the expense of rebuilding at the present high cost of materials.

Personals

City Engineer A. B. Manson, of Stratford, Ont., on the occasion of his departure to join the Canadian Engineers as a lieutenant, received several handsome presentations from the aldermen, the city hall employees, the park board and the officers of the 28th Regiment.

Flight Lieut. Sydney Arthur Hustwitt, a 1914 graduate of the Faculty of Applied Science and Engineering, Toronto, has recently been reported missing. Lieut. Hustwitt was previously with the Canadian Engineers, but subsequently transferred to the Royal Flying Corps. Before his enlistment he had been on the staff of the Welland Canal office.

Mainly Constructional

East and West—From Coast to Coast

The construction and repair work for which permits were issued in Halifax during April amounted in value to $306,850, making the total for the first four months of the year $486,166.

Building permits issued in Welland, Ont., for the month of April are valued at $52,055, as compared with $53,469 in April, 1917. The total for the first four months of the year is $83,695, which compares with $95,349 for the same period last year.

An order-in-council has been passed authorizing the Canaadian Northern Railway to proceed with the construction of the Hanna-Medicine Hat branch of that road. It is proposed to lay rails from Hanna south to the river this summer.

A sardine packing plant is now being erected at West St. John, N.B., above Navy Island, by the Booth Fisheries Company, of Chicago, at a cost of about $75,000. A wharf 160 feet long with a face of 50 feet is also being added to the present wharf.

Building permit figures reported by City Architect Chausse, of Montreal, are as follows: April, 1918, 200 permits, value $648,510; April 1917, 215 permits, $622,940; from January 1 to April 30, 1918, 374 permits, $1,083,325; same period, 1917, 408 permits, $1,618,860.

The Dominion Steel Products Company have purchased 35 acres of land owned by the Water Commission of Brantford, Ont., at a cost of $42,500. The erection of 100 homes for employees of the company will be proceeded with at once and an outlay of $450,000 is planned on development.

The ratepayers of Trenton, Ont., have passed the bylaw to purchase the waterworks system from the Hydro-electric Commission of Ontario, which acquired it from the Seymour Power & Light Company, when that concern was absorbed by the Hydro. The amount involved is $21,000.

Among the items passed on the estimates of the Department of Railways and Canals was a sum of $500,000 for the continuance of the construction of the Trent Canal. An appropriation of $1,850,000 was also passed for construction work on the Welland Canal, and $43,000 for improvements to the Ontario St. Lawrence Canal.

The Dominion Government is expropriating the St. Andrew's College, Toronto, with its 25-acre site, for use as a concentration and hospital centre for returned soldiers. A large building scheme is to be undertaken by the Department of Public Works this summer and an expenditure of over a million dollars is contemplated.

As a result of the visit of Mr. J. F. Whitson, Commissioner of the Northern Development Branch of the Ontario Government, to Rainy River, a good roads association has been formed to cover the territory between that town and Barwick. The official name is "The Rainy River Good Roads Association," and its object, "to co-operate in securing and maintaining good roads in the district in which we reside."

Works Commissioner Harris, of Toronto, will report to the Works Committee at its next meeting, on the construction of a temporary bridge running east and west over Glen Road, as part of the Bloor Street Viaduct. This bridge will accommodate street railway, vehicular and pedestrian traffic. It was not thought advisable to go on with anything of a permanent character, pending the settlement of the fill for the viaduct on both sides of Glen Road.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brooke Township, Ont.
Tenders are being received by the clerk, W. J. Reed, Inwood, until June 1 for repairs to drains for the Township Council.

Cap de la Madeleine, Que.
Town Council contemplate the construction of 6,000 square yards of concrete sidewalks costing $19,000. Chairman, I. Rochefort.

Enniskillen Township, Ont.
Township Council contemplate the construction of several new drains. Clerk, Geo. V. Wyant, Petrolea.

Essex, Ont.
Town Council contemplate the construction of cement sidewalks. Clerk, R. R. Brett.

Fort William, Ont.
The City Council contemplate the construction of macadam pavement on Arthur Street. Engineer, C. B. Symes.

Glencoe, Ont.
Tenders are being received by the clerk, Chas. George, until June 3 for 12-inch tile drain on Main Street for the Town Council.

Mersea Township, Ont.
Tenders will likely be called before June 1 for the construction of a drainage system for the Township Council. Clerk, A. Hairsine, Leamington.

North Tilbury Township, Ont.
Plans are in progress for Trembley Creek drain costing $30,000 for the Township Council. Engineer, J. J. Newman, Davis Block, Windsor.

Ottawa, Ont.
The Beechwood Creamery Company, Central Chambers, contemplate the construction of a tarvia road costing $8,000. Secretary-treasurer, Cecil Bethune, Central Chambers.

The City Council will construct sewer costing $3,000 on Carling Avenue, from Fisher Street to City Limits. Clerk, N. H. T. Lett.

Petite Riviere, Que.
The Municipality of Petite Riviere contemplate the construction of five miles of macadam roadway. Engineer, M. Henry, Roads Dept., Parliament Bldgs., Quebec.

Victoria, B.C.
The City Council will construct asphalt pavement costing $13,000 at the lower end of Yates Street. Clerk, W. J. Dowler.

CONTRACTS AWARDED

Amherstburg, Ont.
Pettypieces Ltd. have the contract for the construction of reinforced concrete pavement and cement curbs on Apsley Street for the Town Council.

Bienville, Que.
M. George Therrien, Fraser Street, Levis, has the general contract for the construction of macadam pavement costing $4,000 on Wolfe Street for the Town Council.

M. Geo. Therrien, Fraser Street, Levis, has the general contract for the construction of concrete sidewalks costing $4,000 for the residents of Wolfe Street.

Cap de la Madeleine, Que.
A. Brosseau has the general contract and is in the market on 20,000 bags of cement and 5,000 cubic yards of crushed stone for the construction of sidewalks costing $3,000 for the Town Council.

Malden Township, Ont.
Thos. Morgan; care of clerk, Howard Gibb, R. R. No. 2, Amherstburg, has the general contract for drainage work for the Township Council.

Tilbury, Ont.
Scratch & Link, Leamington, have the general contract for $7,000 pavement for the Township Council.

Toronto, Ont.
Verrocchio & Castellani, 53 Greenlaw Ave., have the general contract for grading 15,000 cubic yards of roadway at Locust Hill for the Toronto & York Highway Commission, 57 Adelaide St. E.

Trail, B.C.
V. Bianco has the general contract for the construction of sewers costing $3,139 on Green and Riverside Ave. for the City Council.

Virden, Man.
J. E. Boyvin has the general contract for road grading, concrete pipes and culverts for the Town Council.

Railroads, Bridges and Wharves

East Williams Township, Ont.
Tenders will be received by the clerk, Wm. McCallum, Ailsa Craig, until May 26 for the erection of "McArthur" bridge costing $10,000, for the Township Council. Plans and specifications with the engineer, Chas. Talbot, County Bldgs., London.

North Dorchester Township, Ont.
Tenders will be called by the engineer, Chas. Talbot, County Bldg., London, June 1 for the construction of two concrete bridges, 16 feet long, for the Township Council.

Underwood, Ont.
County Council contemplate rebuilding bridge. County clerk, P. A. Malcolmson, Walkerton.

CONTRACTS AWARDED

Blenheim Township, Ont.
Jas. A. Vance, Woodstock, has the floor and steel work and Bain & Ross, embro, the abutments for $12,000 steel bridge for the Township Council.

Minto Township, Ont.
John Tilker, Jr., Harriston, has the general contract for 48-foot concrete truss bridge costing $3,700 for the Township Council.

Moose Jaw, Sask.
J. H. Saunders, Confederation Life Bldg., Winnipeg, has the general contract for mechanical coaling plant, etc., for the Canadian Pacific Railway, head office, Montreal.

Peel Township, Ont.
John Tilker, Harriston, has the general contract for $5,300 concrete arch bridge for the Township Council.

Regina, Sask.
J. H. Saunders, Confederation Life Bldg., Winnipeg, has the general contract for extension to freight shed for the Canadian Pacific Railway, head office, Montreal.

Saskatchewan, Province of
J. H. Saunders, Confederation Life Bldg., Winnipeg, has the general contract for railway buildings, etc., at Weyburn and Swift Current for the Canadian Pacific Railway, head office, Montreal.

St. Pascal, Que.
Arthur Albert has the general contract and will let steel work for the erection of a reinforced concrete bridge over Poivirers Stream for the Town Council.

Wheatland, Man.
Mr. Bradley, Brandon, or care of secretary-treasurer, John A. Dyer, Wheatland, has the general contract for concrete bridge, etc., for the Municipality of Daly.

Public Buildings, Churches and Schools

Alliance, Alta.
The erection of a church is contemplated by the church congregation. Pastor, R. Clegg.

Cap de la Madeleine, Que.
The Roman Catholic Commission will erect two 1½ storey frame schools costing $8,000 each. Secretary-treasurer, Pierre Montplaisir.

Chauvin, Alta.
Tenders are being received for the erection of a school for the Public School Board. Secretary, T. H. Saul.

Durham, Ont.
Plans will be prepared for a church for the Catholic Congregation. Priest, Father Kehoe, Mount Forest.

Fernie, B.C.
Plans are being prepared for a $16,500 school for the School Board. Secretary, Arthur J. Moffatt.

Halifax, N.S.
Tenders will be called shortly for repairs to "Oxford" school for the School

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Special Contract Form Provides Against Changing Prices

OWING to the difficulty of estimating construction costs at the present time, owing to the variations in conditions and prices entering into the work, a special contract form has been drawn up by the Bureau of Yards and Docks of the United States Navy. An interesting description of the form appears in Contracting of May 15:

"In general terms, this form of contract provides that the contractor shall bid on an estimated net cost of work, and add thereto a contractor's estimated profit fee not to exceed 10 per cent. of the estimated cost. If the actual cost of the work is less than the contractor's estimated cost, the contractor shall be paid his estimated profit fee, plus one-half the saving between the estimated cost and the actual cost of the work. If the actual cost exceeds the estimated cost of the work, the contractor receives his estimated profit fee, less one-half the excess between the actual costs and the estimated cost of the work; but in no event shall the contractor receive less than one-third of his profit fee.

"The experience of the bidder is taken into consideration, his available plant, and his financial responsibility. The actual cost of the work includes, in addition to materials, supplies, and labor, allowances for salaries and cost of the field office, plant rental, insurance premiums, transportation expenses, and such other items of expenses as should, in the opinion of the engineer, be included in the cost of the work."

The Part Payment Plan For Industrial Housing

A BOOKLET just published by the Engineering Bureau of the National Lumber Manufacturers' Association, entitled "Housing and Industry," gives some useful information regarding the purchase of houses, built by industrial concerns for their workmen, on a part payment basis. The article points out that the renting of homes is not a satisfactory solution of the "holding labor" situation. The method employed by some large firms at the present day, in order to help their employees to own their own homes, without having to purchase them outright when built, is to build houses costing somewhere about $4,000. Many of these are built entirely of wood, in bungalow style, on lots 50 x 100 feet. Simple and varied designs are used in order to relieve monotony, while the 50 foot frontage leaves considerable ground on each side of the house, adding to the beauty of the surroundings.

The plan of payment by the installment method in general consists of a first payment of 10 per cent. of the full value and a monthly payment of 1 per cent. per month. Thus if the selling price was $4,000, a $400 cash payment was required, with $40 per month until the balance was paid.

Schedule of Payments

In Massachusetts a large company gave its workmen the following schedule of payments:

Your total purchase price is	$3,851.50
You have made a first payment of 10 per cent.	385.15
You are borrowing on mortgage, the balance.	3,466.35
The amount due in 12 years, secured by time note, is	1,000.00
The balance, secured by demand note, is	2,466.35
Your monthly interest during first 12 years will be	14.45
Your monthly payment to co-operative bank will be	5.00
Your total monthly payments during first 12 years	19.45
Your monthly interest payment after 12 years will be	10.30

Total loan	$3,466.35	Demand loan	$2,466.35
Five per cent.	173.32	Five per cent.	123.32
1/12	14.45	1/12	10.30

Special Meeting Saskatchewan Branch C. S. C. E.

On May 23 the Saskatchewan Branch of the Canadian Society of Civil Engineers held a special meeting in the Assiniboia Club, Regina, at which Mr. G. F. Porter, chief construction engineer of the St. Lawrence Bridge Company, gave an illustrated lecture on the construction of the Quebec Bridge. Another interesting feature was the unveiling of the honor roll of the branch by Lieutenant-Governor Lake. A banquet also added to the enjoyment of the evening.

Toronto Bureau of Municipal Research Makes Some Valuable Suggestions

THE fourth annual report of the Toronto Bureau of Municipal Research for the year ending Feb. 28, 1918, has recently been issued. This booklet contains the reports of the council and managing director, financial statements covering the past year and estimates for this present year, also a list of guarantors, members and contributors. In the report of the council, signed by John Macdonald, president, and John I. Sutcliffe, secretary-treasurer, it is stated that during the year, nine meetings of the full council and forty-five of its executive committee have been held, and that the Bureau has pursued its policy of looking into the facts of city government and reporting them to the citizens in as clear and unbiased a way as possible. The report of the managing director goes a little more fully into the work of the Bureau and makes some interesting suggestions and comments regarding civic affairs. With regard to "Municipal trading operations," a quotation is repeated from a former publication of the Bureau, as follows:

Make Civic Departments Self-Supporting

"When the city goes into business, that is, establishes undertakings to be supported like most businesses by revenues arising from the undertakings themselves, and not out of taxation, it does not and should not expect profits, as profits mean that consumers are bearing an additional burden in order that the taxpayer may have a lighter load. On the other hand, the city does, and ought to, expect that such undertakings should carry themselves, otherwise the consumer or user of the publicly-owned utilities is getting his service at less than cost at the expense of the taxpayer, who must pay the deficits.

"As a general proposition, the running of publicly-owned utilities on other than a self-supporting basis is liable to do untold harm to the principle of "public ownership."

The report then continues: "The reasons for making municipal trading operations self-supporting are even stronger now than in 1916. The city cannot afford to build up a tradition of deficits under municipal ownership. It must not adopt any policy which will undermine its financial strength just at the time when the taking over of the street railway is upon us."

Reference is made to the recommendations of the Commissioners of Works and Finance as to increasing the water rates, and it is pointed out that "publicly-owned utilities exist neither for the purpose of reducing the tax rate nor for the purpose of increasing it, but in order to render community services at true cost."

Department Heads Should Form Administrative Board

The report commends the work of the permanent heads of departments and affirms that these heads are the only element in our system of municipal government which works at all strongly for continuity. It says:

"The effect that one man can have if given adequate authority and support is shown by the results of making the City Treasurer, first, Commissioner of Finance, and then, in effect, Budget Commissioner of the city. The only great mistakes that Council seems likely to make during 1918 will probably be failures to adopt measures already recommended by the Finance Commissioner and the Commissioner of Works.

"The natural next step after the endowment of the Commissioner of Finance with the powers and duties of a Budget Commissioner is the formation of an Administrative Board, made up of the heads of the great administrative departments, the Commissioner of Finance acting as Chairman and the City Clerk as Secretary. Such an organization would not require legislation if regarded simply as an advisory committee appointed by Council. Its duties would be to bring about close co-ordination between the departments, to make recommendations to Council as to civic policies, to prepare the tentative budget and, indirectly, to bring about continuity in civic policies and methods of administration. If the proposed board were to work well in practice, it should be given a statutory basis."

Another valuable suggestion is in regard to the formation of a national institute of governmental research and public service. The report that the prevalent educational unrest is but a phase of the general social, economic and political unrest which is making itself felt in all parts of the world, and that if this unrest is to have its full effect in improved conditions of national and community life, some organization must be set up whose business it will be to provide the fact basis upon which action must be taken.

Importance of Fixing Reinforcing Bars While Pouring Concrete

IN order that the reinforced concrete member may be moulded to exact specifications, it is important to prevent the reinforcing from being displaced while the concrete is being poured. An article appears in "Building Age," by A. M. Wolf, C.E., regarding the above important feature in all concrete construction. In the early days of the use of reinforced concrete no special means of holding bars in position were employed. Sometimes an inch or so of concrete was placed, the bars laid on this and the remainder of the concrete poured. Then again, the upper portions of bent bars were supported on blocks of wood which were removed, or rather intended to be removed, after nearly all the concrete was in place. In many cases these were forgotten and left in the concrete. Another practice which is still current in many districts is to place the reinforcement directly on the forms and start pouring concrete. After an inch or more is poured the bars are raised an indefinite amount by a common laborer armed with a hooked bar made for this purpose.

Anyone can readily see that all of the above mentioned methods are nothing more than makeshifts and deserve only condemnation. Where such shiftless methods are used, the actual position of the bars is very likely to be much different than that assumed by the designer, and the strength of the structure is more or less of a "gamble."

This is neither good practice nor economy. The method and means of supporting the reinforcing bars should be clearly indicated on plans, these details being just as important as the proper location of the bends of bars and stirrups. Where bars are bent up into the tops of slabs and beams they can be best supported by cross bars of relatively small size resting on concrete blocks of a height to insure the exact location of bars. Bars in the bottoms of slabs can be kept at the proper height by small Z-shaped metal clips and spacing bars, to which the reinforcing bars are wired.

Where reinforced concrete columns with spiral hooping are used it is essential the spiral be held rigidly from end to end so as to have the pitch of same uniform. This is easily done by the use of continuous spacers (of which there are various kinds) attached to the spirals at the time of fabrication. Three such spacers are sufficient for spirals of small core diameter (say up to 24 ins. diameter), while for larger columns the spirals should have four spacers. The old practice of wiring the spiral at intervals to two or more of the longitudinal bars requires very rigid inspection to insure a good job, and even then there is great danger of the spirals being spread apart or misplaced while concreting the column. When the spirals are kept in shape by continuous spacers, they can be used as a form to wire the longitudinal bars to at the proper spacing, thereby making the entire column reinforcement a unit and eliminating the danger of the steel becoming misplaced while the concrete is poured. The entire reinforcing unit for the column should then be wired to the forms in such a way as to keep the outside covering of concrete as near uniform as possible.

The Method of Devising Supports

Before a concrete structure can be properly erected, someone must devise a means for holding bars in position during construction, and as a general rule a good designer is more capable of handling these details satisfactorily and to good advantage than anyone else. If such detail work is left to the contractor, the owners, if the contractor is a careful bidder, pay very dearly for this "designing service." In many cases it is very poor; on the other hand, if the contractor is not wideawake, he pays the bills. This, it can readily be seen, is neither fair nor economical, and is sure to add to the frequent occurrence of "wild" and "unbalanced" bids, especially on large contracts.

In the flat slab construction it is highly imperative that bars be kept in the proper position, namely, in the top of slab around column heads in the regions of negative moment and in the bottom of the slab at points between columns where the tension occurs in the bottom of the slab. This can be done for the portion where bars are in top of slab by using previously moulded concrete blocks, upon which the supporting bars can be held up from the forms by occasional Z-shaped clips or chains of steel, the bars being wired to transverse spacing bars.

When such methods are used the architect, engineer and owner can rest assured, other conditions being properly attended to, that the strength of a structure is more nearly in accordance with that computed than if the bars are blocked up temporarily on wood blocks which are removed as concreting progresses.

Lowering a Water Main While Under Service Pressure

THE following method of lowering a water main while under full pressure was successfully used by the Water Commission of Middletown, Conn.,

During the summer of 1916 the Water Commissioners of Middletown, Conn., lowered 1,500 feet of 12-inch water main to conform to the new grade of the street. A profile of the pipe line was obtained by digging test holes over the water main at stations of the survey made for the improvement of the street and running levels. The profile of the water main thus obtained was very irregular and far from being parallel with the grade of the street. At many points it was indicated that it would be necessary to lower the main a maximum of 2 feet in order to bring it with its gates and services below frost line, and that the total length to be lowered would be about 1,500 feet. All of the services in the street which had not been renewed in recent years were renewed with lead-lined pipe and lowered. After this was completed a trench was dug along the 12-inch water main down to the proposed new pipe grade at each joint and wood blocking placed under each joint. The earth was then excavated between joints to pipe grade.

The first section to be lowered was 700 feet long. The water main and a hydrant were lowered by means of jack screws placed in pits under the spigot end of each joint with wood blockings. The lowering of the main in this section was successfully accomplished with the water mains under pressure and without cutting the water main or hydrant branch. The joints were of the usual bell and spigot type, with 3-inch sockets calked with oakum and lead. This pipe was originally laid in 1896 and the exterior of it was as good as new; in fact some of the paint markings upon the pipe were as bright as the day it was placed on the pipe. During the process of lowering this pipe no trouble was experienced with leaks.

It was apparent that the method of using jack screws and blocking and the necessary jack screw pits could be improved upon in the next section of 800 feet. Therefore, chain hoists with 6 x 6 timbers laid across the trench as supports were used in lowering this section in which were two intersecting street mains and one fire hydrant. This method was a saving over the jack screw method, in excavation, cost and time of lowering, as it was much more rapid and it was useful also in assuring the safety of operation. The greatest number of hoists that were used simultaneously was four. This method proved to be very successful from every point of view, and no trouble from leaks was experienced in this section. It was not necessary to disconnect or cut the main and hydrant branches and street branches to be lowered, and the mains were kept under full service pressure. It was necessary to disconnect the house services for only short periods. All of the gate valves in this section were carefully inspected and spindles repacked and all pipe joints were recaulked.

The Unit Method of Concrete House Construction

CONSIDERABLE attention is now being directed to the unit method of concrete house construction for the housing of labor. This plan opens up a field for extensive development of cheaper houses of almost indestructible nature, at a cost decreasing with the number and standardization of the units. The method of construction allows the concrete plant to operate continuously, regardless of the progress of the other work, and greatly reduces the cost of forms. These advantages, it is claimed, much more than offset the added cost of rehandling and erecting the slabs after they are cast, which is the only item that would not be required if the houses were poured in place. The use of concrete casting platforms, granulated slag cores for forming hollow wall slabs, and of travelling erection derricks mounted on towers, characterized a piece of work described in Engineering News-Record, and briefly reviewed below.

In a scheme being developed by the Youngstown Steel and Tube Company, Youngstown, Ohio, the dividing walls between houses are hollow, while other slabs cast are ribbed. The exterior slabs are set with the smooth face up, and the ribs, with wood inserts, form studs, to which a lath and plaster wall is secured on the inside. The ceilings of the basement and first floor are beamed, the smooth side of the slab being turned up. With the ceiling of the second floor, however, the rib side of the slabs is turned up, leaving a smooth ceiling below. The window and door openings are cast in the wall slabs, but the window-sills are cast separately. After the sills are placed, the wooden door and window frames are fitted. The cut shows the method of placing the units. The hoisting is done with wire rope slings and hooks, which are fitted into eyebolts embedded in the concrete. The heads of these bolts come inside the form, recesses being cast around them large enough to permit slipping in the hook. The floor slabs have four such rings, so that they can be suspended level, while the wall slabs have rings only in the top edge. The lighter pieces, such as the chimneys and the window-ledges, are set by hand and hoisted in bundles with a sling.

Ceiling slabs picked with four-part sling.

Method of Handling Slabs

The slabs are unloaded and placed by a stiff-leg derrick mounted on three columns, the back pair of columns being surrounded with wood-stave tanks filled with dirt for counterweight. The entire rig weighs 100 tons. The foot of each of these columns rests on a casting containing four rollers, the entire casting being rotated with respect to the column and held in place by a pin. This feature makes it possible to turn the traveller on the short radius. The boom is telescoping, and its length can be varied from 50 to 84 ft. The slabs are set in cement mortar, being handled and placed in the same manner as are masonry blocks in other work.

The Dominion Cabinet have included in their supplementary estimates $152,000 for the Toronto Harbor improvement work. This will make it possible to complete the breakwater which will protect the construction work on the Western Esplanade already finished. This breakwater will be some distance out from the shore and will provide a protected waterway from the western channel to the Humber River. As it lies outside the harbor, this section of the work is being done by the government under the supervision of the Harbour Commission.

Government Transfers St. John Harbor Contract

The Cabinet Council, on the recommendation of the Hon. F. B. Carvell, has authorized the transfer to the St. John Drydock and Shipbuilding Company of the contract originally given to the Norton Griffiths Company for the St. John harbor works. The new company is composed of prominent Canadian ship-owners and builders, and takes over the contract on the terms granted to the Norton Griffiths Company. It is stated that a drydock, capable of handling the largest ocean-going vessels, will be commenced at once, and the necessary harbor works to provide for it and for the proposed big shipbuilding plant in connection therewith will be begun. The government will vote the statutory subsidy for the drydock to be built by the company as soon as the plans and specifications are approved. The total expenditure of the contemplated works is estimated at $7,000,000. The present scheme involves only the necessary governmental expenditures to provide for harbor necessities and the establishment of the shipbuilding industry on a big scale at St. John. The new company has already arranged for contracts for two 10,000-ton steel steamers, the largest craft ever built in Canada.

Consult the Operator When Designing Plant

In any plant it is essential that each unit be so placed that the maximum work is accomplished in any given time, with as low a coefficient of friction and cost as can be obtained. In design, too much stress cannot be laid on the item of co-operation between employer and employees. The old saying that "two heads are better than one" is a good one to follow. In many cases where machinery is being installed, the operator can often give valuable hints whereby a certain arrangement of equipment, for example, would enable him to do more work in less time. He is interested, more especially if on piece work, because it not only means money to his employer but to himself also, not to mention better working conditions.

A number of firms now are offering prizes to their employees, ranging in value according as the suggestion will increase output and lower cost. The system consists in having card-holders placed in each department. If an operator has a suggestion he slips it in the card-holders. These are collected once a week and carefully considered. In this way many points are brought up which would otherwise be lost. It induces the operator to take an interets in his work, increases production, and tends to lessen the percentage of "shifting labor."

The Provincial Builders and Supply Association will hold its annual convention in Galt, Ont., on June 20 and 21, in the S. O. E. Hall. Mr. G. T. Pearce, of Hamilton, president of the association, and Mr. T. R. Wright, of London, secretary, visited Galt recently to make arrangements for the convention, at which it is expected there will be about 150 delegates from all parts of the province. The first day of the gathering will be given over entirely to business, but on the second the local board of trade has undertaken to see that the delegates are provided with an opportunity of making a tour of the city and visiting points of interest and of inspecting some of the larger industrial plants.

Cherry Street Bascule Bridge, Toronto

Opens Up the Way to Industrial District Formed by Harbor Commission —Strauss Type of Lift Span—Movable Leaf Erected in Raised Position

THE new bridge is just about completed spanning the Don channel at the foot of Cherry Street, Toronto. This structure is of considerable industrial importance to the city of Toronto, inasmuch as it will form the main entrance to the newly-formed industrial district. Admittance for pedestrian traffic is now gained by means of a stub line along the bank of the River Don, while wagons and trucks use an old swing span to the east of the present sructure. The Toronto Harbour Commissioners, who have control of the industrial district, are responsible for the erection of the bridge.

Before the contract was let, detail drawings were prepared by the staff of the Harbour Commission for several types of bridges, after which skeleton plans were submitted to the designers of various types of movable bridges with the request that they furnish rough plans and estimates for bridge construction. After going carefully into the situation and considering all the circumstances in connection with the location, it was decided that the Strauss type of bascule bridge would, all things being considered, be best suited for the Cherry Street bridge. Detailed plans having been obtained from the Strauss Bascule Bridge Company, tenders were then called and the contract for the erection of the bridge was awarded to the Dominion Bridge Company. The foundations, however, were designed and constructed by the Engineering Department of the Harbour Commission.

Foundation Work

The foundation consists of four solid piers of concrete resting on rock at a depth of 40 feet. The main trunnion pier is 6 feet in diameter, while the counterweight trunnion pier has a diameter of 8 feet. The piers were constructed by driving steel sheet piling to rock, excavating the sand and filling in with concrete. No difficulties were encountered in carrying out this work. The shore abutments of the structure were built in as a continuation of the Don wall.

General Details

As will be seen from the drawing herewith, the bridge consists essentially of two units. The movable leaf which spans the channel—an ordinary truss of the Warren type—is the bridge proper, while the balance of the structure is really a machine for operating this leaf. The length of the moving span itself is 130 feet, while the clear channel width is 120 feet. The width of the bridge, centre to centre of trusses, is 45 feet. The roadway is 42 feet wide face to face of curbs, with 8 feet clear width of sidewalk on each side, these sidewalks being carried on brackets. The distance centre to centre of car tracks is 11 feet. Between the crown of the roadway and the lateral bracing there is a clearance of 20 feet.

The requirements for structural steel and allowable unit stresses in the structure are in accordance with standard bridge practice. All the steel is painted, with the exception of that enclosed in concrete. The shop coats consist of 12 lbs. of red lead to 10 oz. of lamp black to one gallon of raw linseed oil.

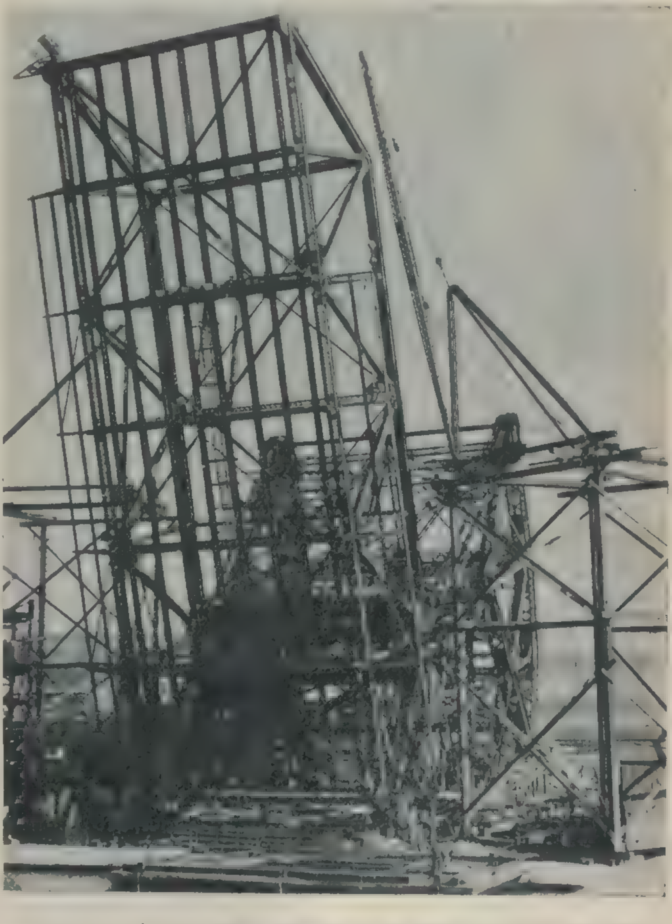
The flooring system consists of 3 inch Norway pine block with 14-lb. carbolineum treatment, over 3½ in. Douglas fir sub-planking, with 12-lb. treatment, which is supported on 6 in. x 9 in. Douglas fir ties with 8-lb. treatment.

The bridge is centrally controlled from the operator's cabin, power being supplied by two 25-cycle, 3-phase, a.c., 710 r.p.m. motors with normal running torque of 740 foot-pounds and maximum torque of 1,600 foot-pounds. Emergency operation is also provided for by a 2-cylinder, 18 h.p., gasoline engine, in case the electric power should be cut off. In order to lock the span in closed position there is an end lock or latch at the outer end of the span, operated by a 5 h.p., a.c. motor running at 825 r.p.m. This latch engages with a casting bolted to the abutment. It is arranged for hand, as well as motor, operation.

A Safety Barrier

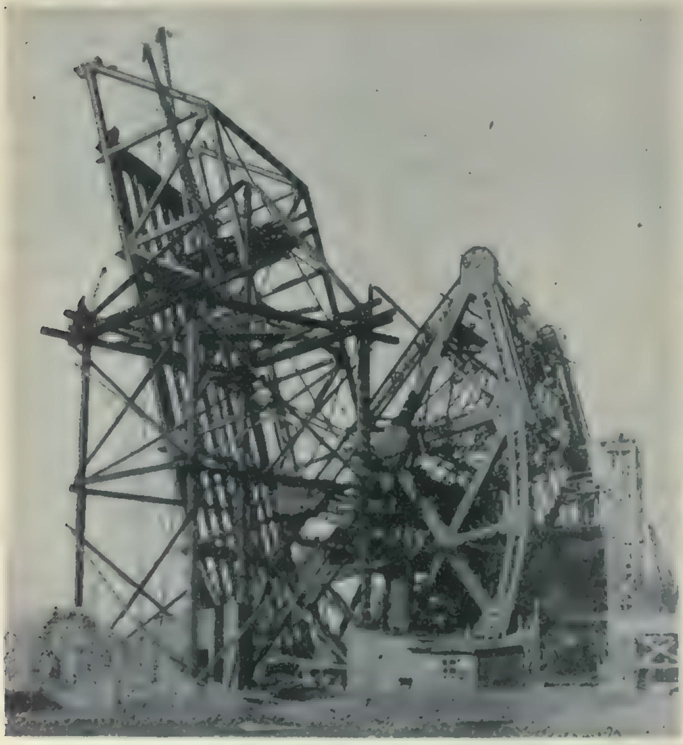
As a safety precaution a barrier is provided at each end of the bridge, to close the approaches preparatory to raising the span. This barrier consists of a chain draw bridge which is raised and lowered by motor. It is also illustrated herewith.

A study of the drawings will indicate the method

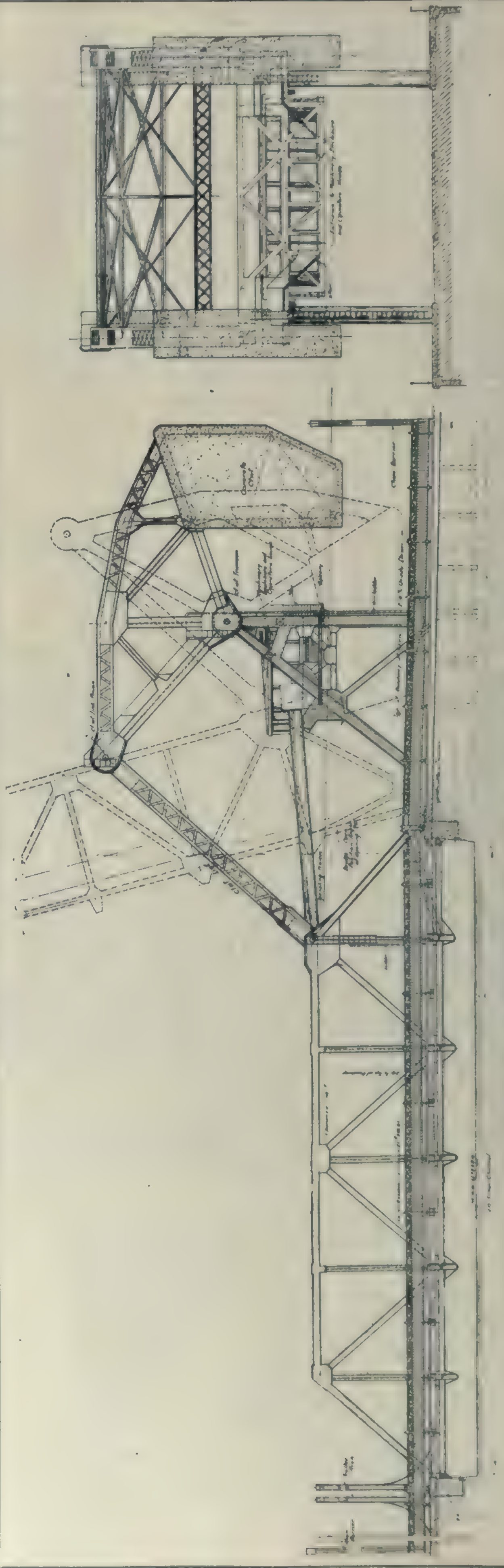


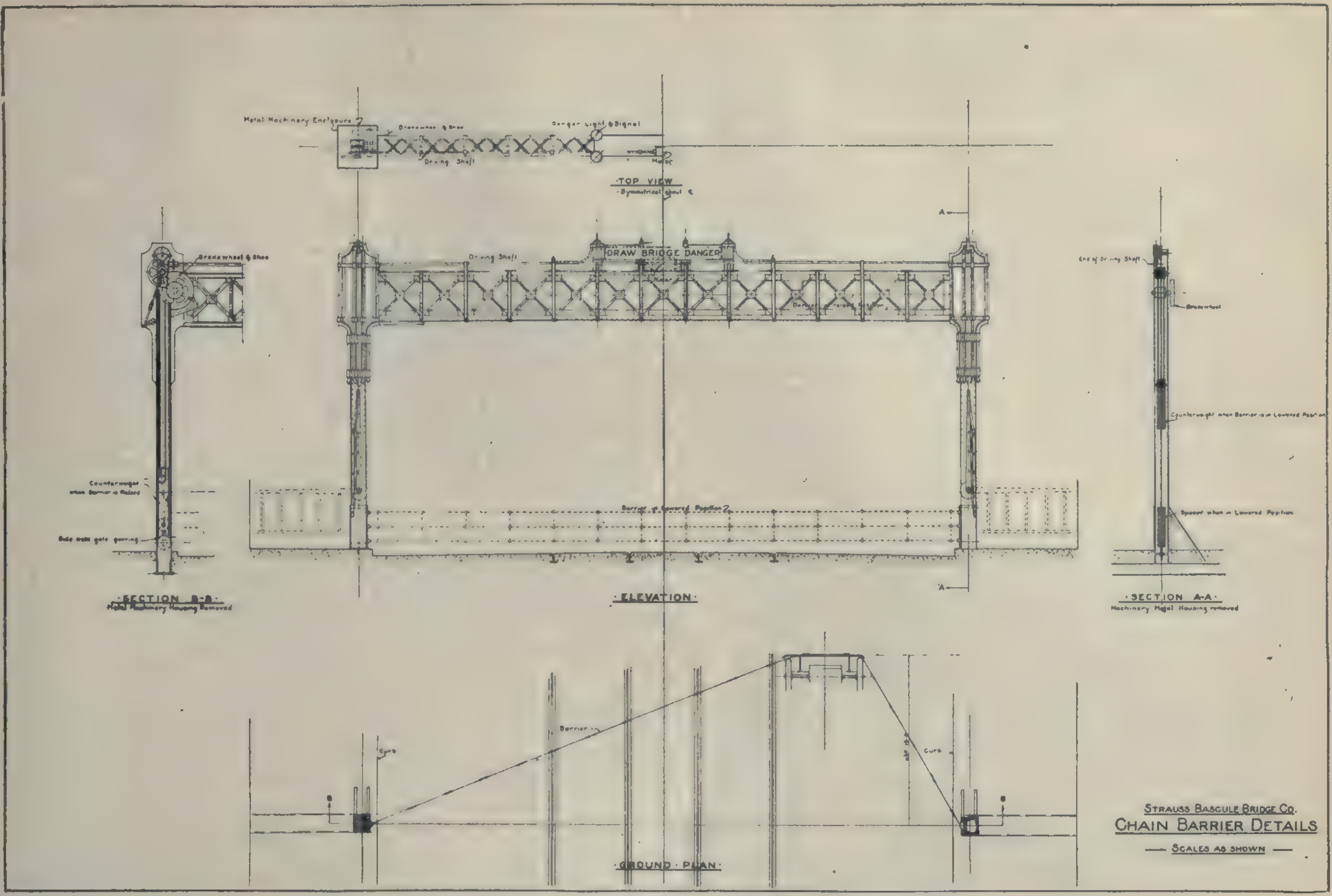
Front view of span showing steel work practically completed—Erection tower on the right.

by which the bascule span is operated. It will be seen that the operating portion of the structure may be considered as consisting of four sections. There is the operator's house containing the motors; the A-frame or tower; the truss to which the counterweight is attached; and a parallelogram bounded on three sides by members of the lift span, the A-frame and counterweight truss, respectively, and on the fourth by the link which connects the counterweight with the moving span. The operating strut is also shown, connected to the end panel point of the moving leaf and running to the operator's cabin. To the under side of this strut a rack is attached which engages a pinion driven by the electric motor. When the channel is to be opened, the motor draws the strut backwards, thus lifting the span, which when raised to the limit assumes the position shown by the dotted lines in the figure, which is at an angle of 76 degrees with the horizontal. At the same time the parallelogram above referred to flattens out, and the concrete counterweight and the truss to which it is attached swing downwards. The mechanism is the same on each side of the structure, and there is a differential gear between the two electric motors to provide for unequal loading due to wind pressure or other causes. The time required for either raising or lowering the span is one minute. The two concrete counterweights are designed to balance with the weight of the span, so that the moving operation requires little power.


Side view shows details of counterweight truss—Concrete counterweight encasing structural steel at lower end poured later.

The main trunnion upon which the moving leaf revolves is 11 inches in diameter, and the trunnion about which the counterweight truss revolves is 32 inches in diameter, bearing on a 12 inch pin. The first link pin, which is on the counterweight truss, is 13 inches in diameter, while the second link pin, on the moving leaf, is 9 inches in diameter and passes through a trunnion with a diameter of 2 ft. 1½ in. This same pin is carried through to support the operating strut, being 8¼ inches in diameter at this point.


Side and end elevation of Cherry Street Bridge—dotted lines show span in open position.



Chain barrier details—Note the flexibility of the barrier as shown in plan.

Concrete Counterweights

The concrete counterweights each contain about 150 cubic yards of material. The mix is 1 of cement, 3 of sand, to 5 of broken stone and iron ore, the iron ore being the heaviest obtainable in order to give the necessary weight of 176 pounds per cubic foot. Careful work was required in designing the counterweights in order that they would balance with the span in all positions, regardless of the change of location of the centres of gravity. They are poured over a steel frame and also contain bar reinforcing. Pockets were left in the concrete to provide for final adjustment to the exact balance.

It will be noted in the end elevation shown in the figure that the lower portion of the counterweights is narrower than the upper, a section being cut off on the inner side. They are given this shape in order to provide clearance with the A-frame when the span is raised and the counterweights swing down.

Very exact work was required on the members for the operating section of the bridge in order that the pins should be exactly in line, as any divergance would have interfered with the revolution of these members around the trunnions.

Emergency Brakes Provided

On each operating strut an emergency air brake is provided. This brake is carried on the same shaft as the main pinion which engages with the strut and it has contact shoes which slide on the top and bottom of the strut.

In order to take care of the trolley wire when the span is raised, there is a drum operated by a counterweight, which winds up the wire as it sags.

Erection

The bridge was erected with the bascule leaf in the raised position, as indicated by the half-tone herewith, taken from recent photographs. Two square timber towers were used, about 60 feet high, each having one 12-ton derrick with a 70-foot steel boom. These carried out all the work on the structure with the exception of a few of the topmost members, which were placed by a boom attached to the bridge itself. The A-frame and the counterweight truss were erected before work was started on the span. In order to prevent stress upon the pins during erection, the counterweight trusses were supported by short steel columns and the span was lashed to the A-frame.

The total cost of the bridge is about $150,000. The contract was awarded to the Dominion Bridge Company about one year ago, and work is now well under way to completion.

Work has recently been started on the building of a branch of the Kettle valley Railway from Princeton, B.C., to Copper Mountain, where the Canada Copper Corporation is proceeding with a development scheme running into millions of dollars. W. P. Tierney & Son have the contract, and next month upwards of 1,000 men will be working. This new branch will cost about $1,000,000. It will be fifteen miles in length and two miles of that distance is declared to be the hardest piece of construction work ever undertaken in the province. There is a total of 27 trestles to be built on the line, four large tunnels, open cuts of great height and one very large fill. The undertaking will take about a year to complete.

Installing Meters on a City's Water Services

IN order to reduce the water consumption, many cities are now installing meter systems. The saving resulting seems to justify this method of procedure. The following article, in the News-Record, by Mr. G. W. Pracy, of the Spring Valley Water Company, deals with the method of metering recently carried out in San Francisco:

During portions of 1916 and 1917 the company which supplies the city of San Francisco with water installed 24,993 meters, practically all of 5/8-in. size, with marked effect in reducing water consumption. Careful records of cost were kept. The methods employed, detailed costs, and the effect on consumption are shown by the accompanying notes, tables, and diagram.

In 1915 the average daily water consumption of San Francisco was 42,635,014 gallons, which was in excess of the developed supply and 3,261,229 gallons over that for 1914. As 1915 was the exposition year, with attendant extraordinary water uses, it was confidently expected that 1916 would see a decrease in the use of water. When instead the first four months of that year showed a substantial increase the problem of adding to or restricting waste was squarely put before the company.

On May 1, 1916, water was supplied through 65,000 service connections, of which about 22,000, or 34 per cent., were metered. These meters were all on business houses. All dwellings were on a flat-rate basis. The company felt that the metering of these flat-rate services was not only the most economical but also the best way of meeting the situation. Accordingly in May, 1916, an order was placed for 15,000 5/8-in. meters, with the option of purchasing a second 15,000 at a later date. This option was taken up at the proper time, a total of 30,000 meters being purchased.

For local reasons it was decided to meter only those consumers whose monthly bills were $1.80 or more. This made the work of setting the meters harder and more costly than metering all houses. All meters were set at the curb.

The Meters

The meter selected was the standard 5/8-in. Inasmuch as only standard makes of meters were considered, price and delivery were the deciding points in making the selection.

The company intended using none but concrete meter boxes. As these could not be delivered fast enough, cast-iron meter plates were used in cement sidewalks. The concrete boxes were used in lawns. Later, concrete covers were used in concrete sidewalks. The concrete covers made a much better job than the cast-iron covers.

Organization and Setting

The field work was done by two crews. For the first month each crew consisted of a foreman and about 30 men. The crews were later cut down to 12 to 15 men. The two foremen were under the general foreman of the service and meter department. A Ford truck and a Ford wagon delivered the meters, boxes, and other material on the ground.

The meters were delivered to the meter shop by the manufacturers. There they were taken out and tested. A testing machine of six-meter capacity was used. Each meter was tested for a 10 cu. ft. flow at the rate of 15 gallons per minute. Meters reading from 99 to 100 per cent. correct were set. Those reading under 99 or over 100 were sent to the bench for readjustment. After testing, the meters were piled up, ready for delivery to the job.

The meter boxes were delivered f.o.b. cars at San Francisco. Thence they were hauled to the yard, where they were stacked The other material was delivered at the yard by the various manufacturers. A large tool box, mounted on wheels, was kept in the locality at which each crew was working. At this tool box was kept about half a day's material for the crew. This enabled the crews to start work at 8 a.m. and continue till the truck arrived.

The Fords were sent out each morning with the material needed for the day. They also moved the tool boxes along as the work progressed. The material was delivered from the tool boxes to the houses by one man using a wheelbarrow. Meter-set orders were written in the main office and given to the general foreman, who routed them and gave them to each gang foreman. The gang foreman, in turn, had a man who took these orders and went ahead of the crews measuring up and marking out the services that were to be metered. The marking was done by chalk on the sidewalk or curb. This man was followed by the laborers, who excavated down to the service and stopcock. If the meter was set in the concrete sidewalk a piece about 2 ft. square was first broken out. In lawns the sod was carefully taken out and set aside. The laborers were followed by the servicemen, who set the meter. The servicemen were then followed by other laborers who set the concrete boxes and filled in. In concrete sidewalks the laborers just filled in, the repaving being done by a contractor. A team followed to clean up and haul away the debris,

Table I.—Average Cost of Installing 24,993 5 8 in. Style 2 Trident Meters on Old Service Connections at San Francisco, Cal., August 1, 1916, to April 30, 1917*

	Cost		
	Total	Per Meter	Percentage
1. Labor	$21,013.84	$0.840	7.93
2. Teaming	2,088.89	0.083	0.79
3. Paving	45,488.48	1.820	17.17
4. Permits	8,934.00	0.357	3.37
5. Material	180,750.16	7.232	68.30
6. Tools	1,202.47	0.048	0.45
7. Miscellaneous	970.96	0.039	0.37
8. Supt., warehouse, etc.	4,354.37	0.170	1.65
	$264,803.17	$10.589	100.00

1. Labor	Sub foreman, $4.25; fitters, $3.75; laborers, $2.50. Eight hours. Average crew consisted of sub foreman, five fitters, ten laborers and one Ford. Set about 63 meters per day. Meters set per man day, 4.25.		
2. Teaming:	Horse drawn vehicles, $1,238.89. Ford auto trucks, $850.		
3. Paving:	Replacing sidewalks and setting plates at 25c per square foot. This charge applies only to 19,524 meters set in sidewalks, and becomes, per meter paved, $2.33.		
4. Permits:	Permit to open paved sidewalks at 50c each. Applies to meters set in paved sidewalks only at 50c each.		
5. Materials:	24,993 meters, f.o.b. yard at $5.95		$149,238.55
	Concrete boxes	.88	5,197.80
	Cast-iron plates	.60 and .65	10,677.74
	Meter couplings	.16 to 19	8,244.27
	Pipe and fittings		7,391.80
	Total		$180,750.16
6. Tools:	New tools purchased, $1,149.39. Tools repaired, $53.08.		
7. General:	Miscellaneous		$346.44
	Carfares		63.65
	Machine shop		114.60
	Stationery		186.40
	Repair sewer vents		170.83
	Clean carpets		27.22
	Replace lawns		61.82
	Total		$970.96

8. Superintendence, employees, insurance, foreman, yard office (proportion), warehouse expense (proportion), auto (proportion of assistant superintendent's and foreman's and all of two sub-foreman's autos, $4,354.37).

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*A few larger meters are included, as well as a small amount of street paving, due to having to shut off at main in some cases. These amounts are practically negligible.

Method of Keeping Records

For each hole made in a paved sidewalk an order was filled out and sent to the paving contractor. This order specified the location, kind of paving, and size of opening.

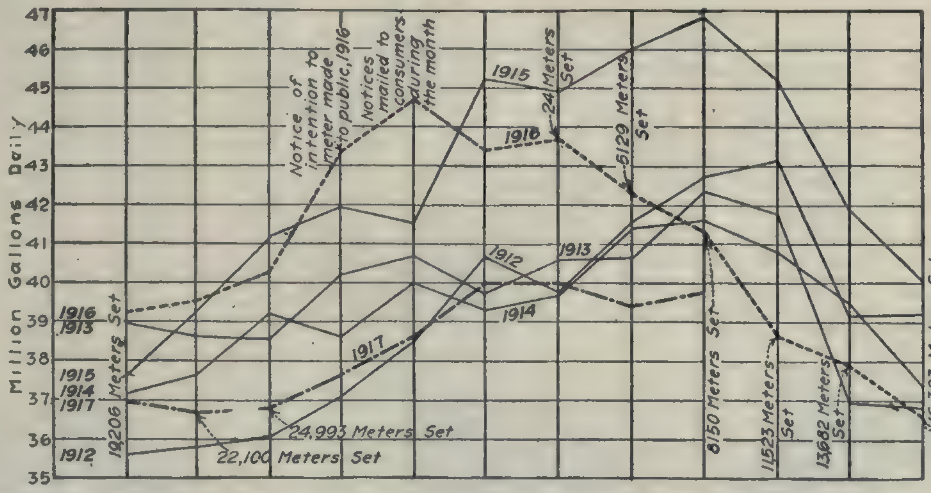
Each serviceman was provided with a pad, on which he wrote the number and location of the meter as it was set, using a new sheet for each. These were collected by the foreman, who checked each one and entered the information on the orders. The servicemen could not make the original entry direct into the meter-set orders, as it was necessary to keep them clean. The orders were then sent to the clerk at the yard, who made out the paving orders. They then went to the main office, where an account was opened for each meter.

Table II.—Detailed Cost of Setting a 5 8-in. Meter

	Paved sidewalks.	Unpaved sidewalks.
Labor	$0.840 including testing)	$0.840 including testing)
Teaming	.083	.083
Paving	2.330	....
Plate	.625	Box .880 including 0.03 handling car to yard)
Permit	.500	....
Material*	6.590 including meter)	6.590 including meter)
Tools	.048	.048
Miscellaneous	.039	.039
Superintendent, etc.†	.170	.170
Total	$11,225	$8.650

*Meter at $5.95 f.o.b. Bryant St. Yard. †Departmental overhead only as far as assistant superintendent.

Approximately 19,524 meters were set in paved sidewalks and 5,473 meters in unpaved sidewalks. In paved sidewalks there occurs a charge for permit to open sidewalk ($0.50), replacing pavement at $0.25 per square foot, amounting in this case to $2.33 per meter paved, and the cost of a cover, either concrete or iron, varying from $0.60 to $0.65 each, say, $0.625. In unpaved sidewalks these costs do not occur, but there is the cost of a concrete meter box ($0.88). In lawn sidewalks the removal and replacement of sod is equivalent to the cost of breaking up concrete walks.



The effect on average daily water consumption of the addition of metres is shown, month by month, through 1916-17.

In the following cost segregation only the difference in paving, materials, and permits has been taken into consideration.

The speed of the crews varied from day to day, depending on various conditions. In the old part of the town, which was burnt over in the fire of 1906 and where the service records were not always correct and the services in poor condition, the least headway was made. In the new residence districts the work went along rapidly. The crews, as a whole, averaged 4½ meters per man per day, though on some days they set as many as 8 per man. Each serviceman set an average of 15 meters a day. A record was kept of the number set by each man, and if any serviceman could not keep up with the rest of the gang he was dropped.

Table III.—Segregation of Labor Costs for Meter Setting

Hauling concrete boxes and covers from railroad to yard	$27.62
Unloading meters from wagon to warehouse	16.92
Testing meters	542.11
Installation of meters	19,215.74
Replacing lawns and gardens	28.42
Miscellaneous yard work	118.62
Services of clerks	562.09
Repairs to sewers broken in setting meters	238.92
Cleaning out sewers	44.68
Locating services with wireless pipe finder	105.40
Rearranging services	79.74
Machine shop	33.58
Total	$21,013.84

Table IV.—Classified Rates of Pay and Time for Labor Used in Setting Meters

	Rate.	Days.	Hours.	Amount.
Foreman	$4.25	447	.	$1,899.75
Fitters	3.75	1,732	.	6,495.00
Helpers	2.75	230	.	632.50
	3.00	220	3	661.12
Laborers	2.50	2,347	6	5,869.37
	2.75	1,198	4	3,295.88
Teamsters	3.00	56	2	168.92
	2.75	63	4	174.63
Miscellaneous	4.00	2	3	9.50
	3.50	2	1	7.44
	3.25	.....	4	1.63
Total		6,299	3	$19,215.74

Making Repairs on Broken Pipes and Clearing the Site

In the old districts the lead services had crystallized and broke very easily when handled. This necessitated frequent repairs with the wet-joint machine. Another trouble was the clogging of sewers by dirt and pieces of concrete as the hole was being excavated. This was overcome by tying a piece of burlap over the sewer vent as soon as the concrete was broken or the sod removed. The paving orders were stamped "Sewer" whenever a sewer vent came inside the broken pavement. This was done after the contractor had paved over several sewers without replacing the sewer plate.

In the lawns the sod was carefully replaced around the meter box. The grass was watered with a solution of lawn fertilizer until it regained the original condition. Few lawns had to be resown. The costs for the job are given in Tables 1 and 4. The effect of the meters on the water consumption is shown in the diagram.

Mr. I. K. Bulger, supervising inspector of steamships on the Pacific Coast, made a remark while on the trial trip of the concrete ship Faith—"Couldn't concrete or cement be used in boiler construction?" The result was that the matter was taken up in detail, and a boiler is now to be constructed. It is estimated that concrete boilers would reduce 90 per cent. of cost of ship construction.

The History and Properties of Paint

Lecture Delivered Before the Extension Course on Industrial Chemistry at McGill University

By Mr. Robert Job[*]

The use of paint for decorative and for preservative purposes dates far back into history, but in the brief space at our disposal we will only consider some of the most prominent types of modern paints and their most important properties.

Paint is described, in a general way, as the mixture of finely-divided particles of solid matter, called the "pigment," in a liquid, called the "vehicle." Asphalt paint is merely solid asphaltum dissolved in benzine or some other vehicle.

The "pigment" functions to hide the surface over which the paint is applied, to resist the action of weather and wear, and to give color. The selection of the most suitable pigment or combination of pigments depends very largely upon the relative importance of these functions under the conditions for which the paint is intended to be used.

The "vehicle" functions as the carrying and cementing body, and dries and binds together the solid particles of pigment in somewhat the same way that portland cement and water unite sand and broken stone to form concrete.

The types of paints best known are three, differentiated by the vehicles used to carry and cement their pigments. The most important are the oil paints, but the enamel paints are now used quite extensively, and cold water paints are daily becoming more popular for interior walls.

Asphalt paint is really a varnish. The varnishes differ from the paints in that they do not ordinarily have a pigment, though occasionally a little is added to give color, and we then approach what is known as "enamel paint."

The oil paints consist of pigment ground in a paint mill, with oil as a vehicle, to which is added a small proportion of Japan drier to cause a fairly rapid solidification when the paint is applied.

Linseed oil, which is pressed from flaxseed, is the best known vehicle used in the oil paints. Until recent years it was employed for all the better paints of this type, but it has the defect that a film of it is readily penetrated by water.

Other vehicles, as substitutes and improvements, were diligently sought, because of this unfortunate non-waterproof property of linseed oil. Among others, fish oil, Soya bean oil, and corn oil have been carefully tested and successfully used under certain conditions, but the greatest advance has been made by using China wood oil. China wood oil, when properly manufactured, is very resistant to water, and it is largely employed at the present time in the manufacture of both paints and varnishes.

The enamel paint consist of pigment ground in a vehicle of varnish, which consists ordinarily of gum or resin, oil, and turpentine. The evaporation of the turpentine leaves the gum and oil as a strong cementing medium for the pigment. Some of these enamels are very serviceable and resistant to weather, and the coating dries with an excellent gloss.

Cold water paints consist of pigment combined with gum, caslin, etc., that dissolves in water to form the vehicle at the time of application. The evaporation of the water leaves the gum to serve as the cementing medium for the pigment. Some paints of this type have very fair weather resistance.

White lead pigment is one of the oldest and best known. It was originally made from pieces of metallic lead, called "buckles," that were corroded to form the white powder termed "basic carbonate," and known as "white lead." This process is largely used at the present time, though other methods have been adopted to shorten the period required for manufacture and to improve the product. White lead, as first produced, is purified, dried, and powdered before being sent to the paint mill.

White lead paint, when the pigment is properly ground with an oil vehicle of good grade, has very great covering and hiding qualities. Unfortunately, it also has certain disadvantages. It is very poisonous, and on exposure to weather it has the property of "chalking." When one's hand is rubbed over a board

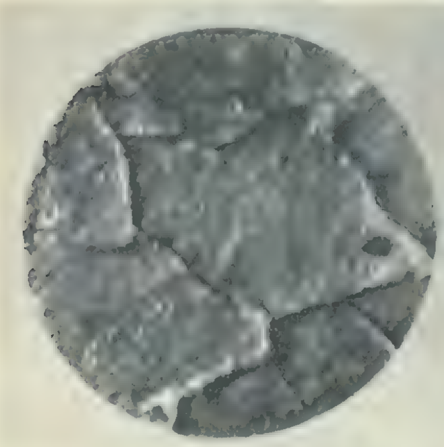


Fig. 1

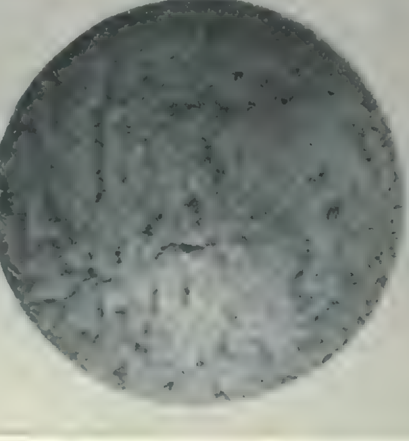


Fig. 2

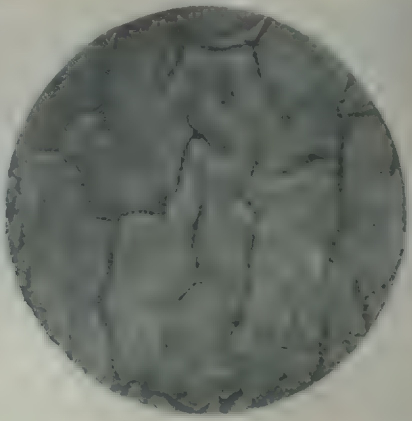


Fig. 3

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[*] Vice-president Milton Hersey Co., Ltd.

which has been painted with it for a year or more the hand becomes coated with a white powder. Chemical action between the white lead and the oil causes the change in a white lead paint film, and this action is so marked that in the course of a few years the house which has been covered with an excellent quality of white lead paint may be but poorly protected, especially if it is exposed to salt sea air. Fig. 1 shows the general appearance of this condition when examined with a magnifying glass; while Fig. 2 shows the condition in contrast of a better proportioned paint subjected to exactly the same exposure and use.

Zinc oxide pigment is another which is well and favorably known. Owing to its non-poisonous properties it is more desirable than white lead for interior work. This pigment used alone is also unsatisfactory, as it produces a brittle coating that is liable to crack, as illustrated by Fig. 3. Other pigments commonly used are red oxide of iron, ochre, sienna, ultramarine, Prussian blue, chrome yellow, lamp black, and many besides too numerous to mention.

Co-operation is as effective in promoting efficiency with pigments as with people, and by far the best results have been obtained with paints in which suitable pigments have been properly combined.

Little was known about the reactions between pigments and vehicles, or the reasons for good or bad service of paints made from given materials, until comparatively recent times. Certain bad combinations were shunned, from sad experience. It was learned, for instance, that white lead paint mixed with ultramarine blue will darken, owing to the formation of black sulphide of lead, and that a sign coated with white lead paint will sometimes change from white to yellow within an hour if exposed to the sulphur fumes from a locomotive.

The study of paints was given great impetus, about the year 1890, through the published investigations of Dr. Charles B. Dudley, for many years the able, widely-known, and respected chemist of the Pennsylvania Railroad. In his studies, among other things, the properties of paint materials were systematically investigated, and what was learned brought about radical changes in the composition and manufacture of paints. The Pennsylvania Railroad gained much valuable information as the result of Dr. Dudley's work. It was clearly realized, for example, that the effectiveness of a paint did not by any means depend upon its cost per gallon or pound. As a matter of fact, it was proven that some of the most durable paints could be obtained at a minimum cost. Other railroads were not slow to follow the lead of the Pennsylvania, one of the first to start on this work being the Philadelphia and Reading, now known as the Reading Railway. The results of some of these investigations were presented by the writer before the Franklin Institute and elsewhere.

Size of Pigment Particles

The size and form of the particles of the pigment were shown to have a great influence upon the life of a paint coating, though this subject had not previously received any attention. A brief description of a case that clearly illustrates this point may be of interest:

Two bridge paints had been used upon the lines of the Reading for a period of about ten years. These paints were made by the same manufacturer, and contained almost the same proportions of the same materials. Though they were exposed side by side and under like conditions all along the road, one of them became known for its good service and the other for very poor service. The life of one was twice that of the other. The difference between the service renderd by these paints was so marked that we determined to get at the real causes, so as to bring the quality of all our paint deliveries to the same high standard of durability represented by the better paint. The discovery that the main difference between the two paints was in the relative size of the particles of the pigments resulted from this investigation. In the long-lived paint these particles ranged from two to ten ten-thousandths of an inch in diameter, with comparatively few of the maximum sizes, while in the short-lived paint the diameters ranged from two to one-hundred and eighty ten-thousandths of an inch.

The average diameter, as nearly as we could estimate, of the particles of the pigment of the satisfactory paint was four ten-thousandths of an inch, against eighty ten-thousands of an inch for the unsatisfactory paint; and, as the volumes of spheres are to one another as the cubes of their diameters, it follows that the average particle of the pigment of the good paint was eight thousand times smaller in volume than that of the bad.

The composition of these two paints was about 75 per cent. oxide of iron, combined with inert matter, such as clay and gypsum, as a filler, ground in pure linseed oil, with a small proportion of Japan drier, as a vehicle. The details of the investigation may be found in the Journal of the Franklin Institute for July, 1904.

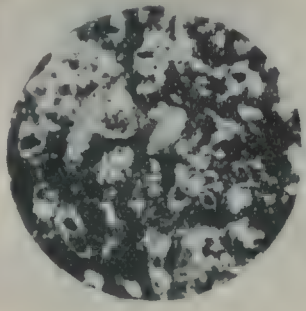
Fig. 4

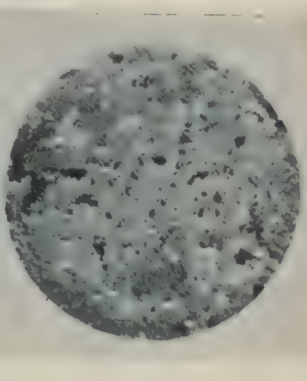
Fig. 5

The reason why this difference in the size of the particles of pigment makes so marked a showing in the service of the two paints is that where the particles are coarse, relatively large oil spaces surround them; and as linseed oil is by no means waterproof, as we have mentioned, the effect of the weather is soon noticed in such paints. Surface tension also operates in favor of the paint having the finer-particled pigment, on the same principle that fine sand, when wet, holds together, where coarse sand or gravel will not.

Fig. 4 shows the appearance of a paint film of the short-lived coarse-particles-pigment paint, and Fig. 5 shows that which had fine-particled-pigment and was long-lived.

These tests demonstrated that some of the most durable paints were composed of the simplest and least expensive of pigments, and created a good deal of interest because the findings ran counter to the preconceived ideas of many who had assumed that in order to be really good and give long service a paint must be composed of one of the more expensive pigments, such as white lead, and that those which contained the so-called "inert materials" were to be looked upon as "doped" products. Because of mis-branding and wholesale and indiscriminate adulteration the manufacturers were, in some cases, to blame for this. For example, we have seen a supposedly oil paint that contained 30 per cent. of water. Another paint labeled "pure white lead" contained no white lead. Many other cases could be cited, and it is small wonder that such abuses led to a public outcry and legislation that was sometimes carried too far. It became necessary, because of these conditions, to determine the truths about the properties and characteristics of the different paint materials, and the work was finally undertaken by the Scientific Section of the Paint Manufacturers' Association of the United States. A fence was built at Atlantic City and several hundred panels were coated with paints of different formulae in order to determine the value under exposure to the weather at the sea shore of the more important materials used as pigments, and also to show the most durable combinations of the various pigments under such conditions. Exposures were made on both iron and steel panels as well, and, subsequently, test fences were erected in other parts of the country in order to get varying climatic conditions. The tests were made under the supervision of the American Society for Testing Materials, and a vast fund of information regarding the service value of various compositions and combinations was obtained. Materials that many considered as adulterants not long ago are now known to have a definite value in the design of high-grade paints.

Misrepresentation still exists under the stress of competition, but the general plane of the paint industry is distinctly better, for the simple reason that the principles of manufacture, the relation between cause and effect as applied to paints, and the properties of paint materials, are all far more thoroughly understood than was the case even at the beginning of the twentieth century.

Qualities and Specifications

It will be clear from what has now been said that in order to be serviceable a paint must be composed of a pigment that is of a character well adapted to the conditions under which it is used; that this material must be in the most effective physical condition, and must be carried in a vehicle which will form an effective bond between its particles, and at the same time be as nearly weatherproof as possible.

The spreading quality is a factor that should be very carefully borne in mind when purchasing paints. That having the pigment composed of the most finely divided particles, other things being equal, will spread farthest. Specific gravity is another important factor, and should be studied accurately by the purchasing agent who is buying by the pound. The paint of the least specific gravity will be the greatest in bulk; and it is bulk, not weight, that counts in determining the spreading capacity of paints. The labor cost of applying the paint is usually far greater than the cost of the paint itself; and it is important to remember this as a special incentive for the purchasing of the most durable paint for the purpose.

Specifications for various types of paints were the natural outcome of all the foregoing investigations and experiments with paints and paint materials. Such specifications have been drawn by the writer and others to cover paints for use under many different conditions, and these can be filled by any manufacturer who is willing to give care and attention to the work. Some of them, in fact, now carry these preparations in regular stock.

By purchasing wisely, under carefully-drawn specifications, real competitive prices that represent the true market value of the paint materials, plus a reasonable allowance for the costs and profits of manufacture, can be secured.

Marked economies have been effected by some of the principal railroads and by many smaller users of paints, through lowered costs and increased service, as a result of working along these lines. Large purchasers know they cannot afford to do otherwise than buy according to specifications specially drawn to cover the needs of the service. It would be much to the advantage of many of the smaller purchasers who use quantities that would warrant the small expense connected therewith if they would do likewise.

Final testing is, of course, absolutely necessary, for it is useless to buy according to specifications, or even on promises, unless the paints actually delivered are tested to determine whether they are as specified or represented.

New Church for Montreal

VIAU & VENNE, architects, Montreal, have drawn plans for a Roman Catholic church for the parish of St. Stanislas, Montreal, the general contract having been let to Ulric Boileau, Ltd., Montreal. The church is being constructed on a site 300 x 200 ft., on St. Joseph Boulevard East. It will be in the form of a Roman cross, the design being in the Romanesque style of architecture

The building will be as fireproof as it is possible to make it, reinforced concrete, marble, and incombustible material being almost exclusively employed. The exterior is of stone, backed with brick and terra cotta, while in the interior marble and concrete is freely used; the partitions are of terra cotta.

Below the main church is a sub-church, to be used for meetings, children's masses, etc. The plans of the upper church provide for a colonnade, of marble, down each side of the nave, with a marriage altar on the left side, and sacristies and priests' vestry; a vestry for the choir boys will be located in the sub-church, beneath the priests' vestry.

Three altars are to be situated in the sanctuary, which is to be semi-circular in form, the main altar being under a baldaquino. The main altar will be of marble; stalls, balustrade, and communion rails will be constructed of incombustible material.

The interior scheme of decoration will include a large amount of modelling and relief work. The vault is to be of reinforced concrete. All the floors will be of terrazo.

The entrances will be on three sides. The main one, on St. Joseph Boulevard, will consist of five doors, three leading to the upper church and one on each side leading to the sub-church. The stairways will be constructed of marble and concrete.

Local stone is to be used for the exterior of the walls and towers. Stairways, of marble, with wrought-iron hand-rails, are to be located in the towers, leading to a public gallery, and also to the organ and choir gallery.

Heating will be by a forced system, provision being made in the basement for the heating and ventilating apparatus, coal bins, etc.

The following sub-contracts have been let: Steel, Trussed Concrete Steel Company, Montreal; roofing and plumbing, Michael Chouinard, Maisonneuve; electrical work, J. A. St. Amour, Montreal; painting, T. A. Gauthier, Montreal; marble and tile, Lepage Marble Works, Ltd., Montreal.

Construction of Tar Surfaces and Pavements

Paper Dealing With English and American Practice— Describes Methods, Materials and Types of Roadways

By Arthur H Blanchard*

THE use of tar in the construction of bituminous pavements dates back to 1820, when a tar macadam pavement was laid in London. In 1834, an English patent was issued covering some of the features of the modern Pitchmac pavement. Tar concrete pavements probably were first built about 1840, in Nottingham, England. In Canada, tar concrete pavements were constructed in the province of Ontario in the period from 1880 to 1891. Highway engineers in the United States have used tar concrete pavements in municipalities since about 1870. It was not until 1906, however, that tar concrete was given consideration as a pavement for use on state highways. After conducting service tests for three years, Rhode Island, in 1909, was the first state to adopt the tar concrete pavement as a standard type for use on highways outside urban districts. Tar was first used for surface treatments in France in 1871. In the United States thin tar surfaces were first employed in Montclair, N.J., in 1894. In America, however, the rapid development of the use of tar for surface treatments did not begin until 1906.

TAR SURFACES

Tar surfaces may be considered as divided into two classes. The first class consists of thin superficial coats of tar with or without the addition of such materials as stone chips, fine gravel or sand. When this type of tar surface has been under traffic for from one to two years, the road metal, or other material composing the wearing course, is exposed. The second class consists of coats of tarred material of appreciable thickness, usually over one-half inch, and are formed by the application of one or more treatments of tar with sand, gravel or stone chips added. Surfaces of this class are known as tar carpets or blankets. They rarely wear down uniformly to the wearing course and hence increase unevenly in thickness by retreatments.

Construction

Before constructing a tar surface on a broken stone or gravel road, every precaution should be taken to secure the best sub-drainage which is practicable under the local conditions. All depressions, pot-holes, ruts, or other irregularities should be filled with thoroughly compacted tar-coated stone so that the whole surface of the roadway is even. All surplus dust must be removed so that the larger pieces of broken stone of the roadway surface are exposed but without breaking the bond. This cleaning process is accomplished by the use of horse sweepers and fine bass brooms, with coarse fiber brooms and fine bass brooms, or by a vacuum process. If there is caked mud on the surface of the roadway, wet brushing will prove advantageous.

It is apparent that the character of the cleaned surface will be affected by the method which was used in the original construction of the roadway. If the practice of some English and American engineers in using large-size stone varying from 1 to 2½ inches in longest dimensions for the top course of a broken stone road is followed, and the stone is hard and tough, the desired surface can be easily secured. The surface of the large stones in such a roadway are easily cleaned by brushing without the dislodgment of stones in the surface. A clean mosaic surface is of the utmost importance from the standpoint of the formation of a satisfactory bond between the broken stone and the tar. The maintenance of tar surfaces on wearing courses of large broken stone is economical, since after the tar surfaces wears away in spots, the mechanically interlocked large stones will of themselves generally have sufficient stability to withstand the effects of traffic until retreated. On the other hand, if the top course of a broken stone road has been constructed of a product varying in size from ¼ to 1¼ inches, it will be very difficult, if not impossible in the case of soft stone to secure an even, clean surface. Even after thorough brushing, a film of impalpable dust usually covers the surface of the roadway. During hard brushing small depressions will probably be formed by the displacement of pockets of dust and the smaller sizes of stone. Furthermore, the wheels of vehicles may adhere to the tar and thus tear up the small mineral matter adhering to it. As soon as the tar surface wears out in spots, rapid disintegration of the exposed broken stone or gravel surface, with the consequent formation of pot-holes, is apt to occur.

If a tar surface is to be constructed on a new broken stone or gravel road, or on one which has just been resurfaced, the tar should not be applied until the crust has had time to consolidate under the action of traffic and with the aid of the binding action of dust and moisture. If it is impracticable to postpone the surface treatment, special care should be taken to secure a maximum consolidation of the crust of the roadway by puddling and rolling.

When the tar is applied the roadway surface should be bone dry. If the surface is damp it will be difficult to secure a good bond. Distribution of the tar is accompanied by two methods. Flow by gravity is utilized in one method and mechanical pressure in the other. The use of gravity distributors has not been developed to its fullest extent in America, in that the use of mechanical brushes or the brushing of the material into the road by hand brooming has never been adopted extensively. By brushing after gravity distribution, it is possible to distribute uniformly 1/4 to 1/5 gallons of tar per square yard. In some cases, when the distribution is accomplished by hand brooming, the adhesion of the material to the road metal is as good as when the material is applied under pressure. The advantages claimed for pressure distributors are: aid in cleaning the surface of the roadway, even application, distribution of small amounts per square yard, satisfactory adhesion obtained between the tar and the surface of a clean, dry roadway, and rapid and economical distribution.

As a general rule from ¼ to ½ gallon per square yard is used for the first treatment, preferably in two applications. The amount applied per treatment depends upon the kind of tar, the character and condition of the surface, and the details of the method of application. For example: A smooth surface composed of large sized, tough, hard stone and well compacted by traffic, would require from 0.25 to 0.35 gallons; for a somewhat rough surface of stone having a medium toughness and hardness and recently resurfaced, it would be necessary to use from 0.35 to 0.5 gallons per square yard to form a satisfactory thin tar surface.

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* Consulting Highway Engineer, New York, before Fifth Canadian Good Roads Congress, Hamilton.

The superficial coat of tar is usually covered with either coarse sand, fine gravel, or stone chips varying from ⅛ to ½ inch in longest dimensions. Material containing clay should not be used as disintegration may result by the emulsifying of the clay and water on the tar surface. The amount of sand, stone chips, or gravel used per square yard depends upon the quantity and kind of the tar, and the character of the surface of the roadway. From 5 to 20 pounds per square yard have been used satisfactorily for thin tar surfaces; 5 to 12 pounds for from 0.1 to 0.25 gallons of tar per square yard; 10 to 17 pounds for 0.25 to 0.35 gallons; and 15 to 20 pounds for from 0.35 to 0.5 gallons.

Cost Data

Under normal conditions, with labor and foreman at $2.00 and $4.00 respectively for an 8-hour day, teams $5.00 per day; refined tar applied, 7 to 9 cents per gallon; and top covering $2.00 to $2.25 per ton delivered; the cost of tar surfaces, using from 0.25 to 0.4 gallons of tar per square yard, will vary from 4 to 8 cents.

TAR MACADAM PAVEMENTS

A tar macadam pavement is one having a wearing course of macadam with the interstices filled by a penetration method with a tar cement.

Foundations

Usually tar macadam pavements are constructed on broken stone or gravel foundations. In cases where traffic conditions require rigid foundations or where materials satisfactory for cement-concrete may be secured at a much lower cost than broken stone, cement-concrete foundations have been used and have been found to be satisfactory and economical. The more general use of cement-concrete foundations is advisable on trunk or other highways where traffic is liable to increase rapidly, both in amount and weight. When it is necessary to construct a more durable type of wearing course than tar macadam, the cement-concrete foundation previously constructed proves a valuable asset and allows reconstruction to be accomplished economically.

Physical Properties of Road Metal

The weight to be given to toughness and resistance to abrasion depends primarily upon the traffic to which the pavement will be subjected and the details of the method of construction adopted. For example, for many highways serving as feeders to state trunk routes, a rock having a toughness of not less than 6 and an abrasion loss of not more than 6 per cent. would prove economical and satisfactory; but if used on state trunk highways subjected to horse-drawn or motor trucks, rock having a toughness of not less than 13 and an abrasion loss of not more than 3.5 per cent. should be employed. In cases where rock with suitable toughness and wearing quality is not locally available, satisfactory results may be obtained by importing the broken stone for the surface of the pavement and using local rock for the lower part of the crust.

In order that road metal should interlock during compaction and thus provide a stable wearing course, a proper angularity is an important prerequisite. The road metal should not contain over 5 per cent. of particles having small acute angles, nor should the product contain slivers. Road metal which has a rough or coarse grain or pitted surface is preferable to material with smooth or glassy surfaces as the tar cement adheres more satisfactorily to the former than to the latter. Cleanliness is an essential quality of road metal for the wearing course of tar macadam pavements. It is difficult and usually impossible to secure a good adhesion of the tar cement to road metal which is not clean.

Construction

In the construction of tar macadam pavement it is desired to secure, (1) a stable wearing course consisting of broken stone or similar material thoroughly rolled so that it will be well compacted and keyed together and with the several sizes of material uniformly distributed, and (2) a uniform distribution and penetration of the tar within the upper 1½ to 3 inches of the crust. Several methods of construction have been devised with a view to meeting the above prerequisites. Careful supervision, based on experience, is necessary to prevent non-uniformity in the density of the wearing course of broken stone and in the amount of tar applied per square yard. It is evident that uniform application of the tar will depend upon the method of distribution employed. In using vehicular distributors, one cause of uneven distribution of the tar is overlapping of applications. The use of strips of tar or wrapping paper, from 3 to 5 feet in width, placed at the edge of an application has prevented sections of the wearing course receiving double the amount of tar cement specified.

A typical American method of construction is as follows: The metalling of the wearing course is a uniform product of about 1 or 1½ inches in size or a product similar to or larger than one passing over a 1½ inch and though a 2½ inch screen, and the voids in the upper part of the wearing course are filled after the tar cement is applied. Practice varies with reference to the amount of rolling of the wearing course prior to the application of the tar cement. For traffic, medium or heavy in weight and amount, the best results have been secured by thoroughly rolling the road metal and thus securing maximum interlocking of the particles and thereby securing the highest degree of stability practicable by this method. The tar cement is applied in an amount varying from 1½ to 2 gallons per square yard, after which ⅜-inch stone chips or a product similar to one passing a ½-inch and through a 1-inch screen is spread and thoroughly rolled. Usually the surface is then broomed with stiff brooms, removing the excess loose broken stone, and another coat of tar cement, from 1/3 to 1 gallon per square yard is applied, covered with a layer of stone chips or pea gravel and rolled.

A tar macadam pavement called Pitchmac by its inventor, J. A. Brodie, city engineer of Liverpool, has been used to a considerable extent in England, and has been adopted as a standard type by the Road Board of England. It is constructed on a foundation of stone. The wearing course of broken stone varies from 2 to 4½ inches in depth, dependent upon traffic conditions. If the wearing course is from 2 to 3 inches in thickness, it is constructed in one layer, and if from 4 to 4½ inches, in two layers. The single layer, and, in the case of two layers, the upper layer is composed of broken stone ranging in size from 1¼ to 2½ inches. After thorough rolling the tar compound is applied to the single layer or to each of the layers of the two-layer wearing course. The tar compound used in England consists of hot sand mixed with tar pitch. From 1¼ to 2 gallons per square yard are used for the one-layer wearing course and from 3¼ to 3½ gallons for two layers. To assist in completely filling the voids, chips varying in size from ⅜ to ¾ inches are applied during the rolling of the tar grouted layer. The oldest sample of Pitchmac in Liverpool was laid in Princes Avenue in 1901, near the end of Eversley Street, and has been in continuous use ever since without repair. This avenue carries a large volume of light motor and carriage traffic, as well as some of a heavier character, the traffic amounting to 120,000 tons per yard width per annum.

Pitchmac has been used to a limited extent in Massachusetts. The writer is indebted to Mr. Arthur W. Dean, chief engineer of the Massachusetts Highway Commission, for the following authoritative and instructive data covering the cost of construction and maintenance of Pitchmac pavements having top courses of 2 inches filled with tar and sand and foundation courses of 4 inches of broken stone.

Tyngsboro W.	1913	$1.01	$0.0118	Good	Medium
Natick E.	1914	1.12	0.0191	Good	Heavy
Newton	1914	1.21	0.0118	Good	Medium
Reading S.	1914	1.18	0.0266	Good	Very Heavy
Wayland	1914	1.46	0.0175	Good	Very Heavy
Gloucester W.	1915	1.15	0.0141	Good	Medium
Boston	1916	1.20	0.0000	Good	Heavy

Notes: The character of traffic on the several sections is as follows:

Tyngsboro W.—Heavy pleasure travel, truck and logging teams, in spring and fall.

Natick E.—Pleasure cars, trucks, between Framingham and Boston.

Newton.—Pleasure cars 70 per cent., 15 per cent. trucks, 15 per cent. teaming.

Reading S.—Pleasure cars. Very heavy trucking.

Wayland.—Pleasure cars. Very heavy trucking.

Gloucester W.—Pleasure cars 80 per cent., trucks 10 per cent., team 10 per cent.

Boston.—Mostly trucks and teaming, pleasure cars 30 per cent.

Maintenance cost is average per square yard per year since surface was laid and with exception of Reading S. is entirely for sanding. There having been no repairs made nor necessary nor probably will be for some years. At Reading the contractor had poor workmen and early corrections were necessary on that account. The sanding was necessary mostly on account of surplus tar on surface and perhaps 25 per cent. for slipperiness during cold weather. Notice no repair expense at Boston, due to perfect workmanship. This is partly the result of experience, as it is the latest piece laid and can be equalled under favorable conditions.

Distributors

The appliances used in the distribution of tar cements may be classified as gravity distributors and pressure distributors. The market is supplied with so many different types that a thorough investigation should be made preceding the purchase of a machine. The following factors should be given consideration when selecting a distributor: (1) character and range of work upon which the distributor will be used; (2) present and probable requirements in specifications pertaining to type and details of distributors and the work to be done; (3) different types and grades of tar cements which the machine will distribute, and the range in the amount per square yard which can be applied; (4) gravity or pressure distribution, and, if the latter, the range in pressure per square inch; (5) method of controlling uniformity and amount of distribution; (6) accessories of distributors for heating material, recording temperature of tar cement, amount in tank, and amount of pressure, and shutting off tar cement at end of run; (7) width of distribution and means for modifying same; (8) motive power; (9) width of tires and loads per linear inch of tires when tank is full; (10) ease of operation and repair; (11) structural strength; (12) amount and character of labor required to efficiently operate the distributor; (13) economics, including overhead, operation and maintenance charges.

Cost Data

The cost of tar pavements, built by penetration methods, varies with the amount and kind of tar cement and road metal used, and the method of construction employed. An average cost, using 6 to 8 inches of compacted broken stone and a total of 2 to 2¾ gallons of tar cement per square yard varies from 25 to 40 cents per square yard in excess of the cost of water-bound broken stone roads, or from 70 cents to $1.25 per square yard .

TAR CONCRETE PAVEMENTS

A tar concrete is one composed of broken stone, broken slag, gravel or shell, with or without sand, Portland cement, fine inert material or combinations thereof, and a tar cement incorporated together by a mixing method.

Classification

Tar concrete pavements may generally be grouped in three classes. The essential characteristics of the three classes are as follows:

Class A.—A tar concrete pavement having a mineral aggregate composed of one product of a crushing or screening plant.

Class B.—A tar concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing or screening plant and a certain number of parts by weight or volume of sand, broken stone screenings or similar material, with or without a filler.

Class C.—A tar concrete pavement having a predetermined mechanically graded aggregate composed of broken stone, broken slag, gravel or shell, with or without sand, portland cement, fine inert material or combinations thereof.

Patent Litigation

In connection with the design or selection of a suitable type of tar concrete pavement, it is necessary to consider the possibility of an infringement suit being brought by one of the patentees of proprietary pavements. Highway engineers and contractors are primarily interested in the types of tar concrete pavements which may be constructed without danger of litigation rather than in a voluminous discussion of the probabilities of successfully defending infringement suits.

Class A.—There is ample evidence at hand that tar concrete pavements of Class A may be constructed without danger of litigation proceedings.

Class B.—The history of litigation cases indicates that the construction of unpatented tar concrete pavements of Class B on a large scale will, in all probability, lead to an infringement suit.

Class C.—With the exception of the class of tar concrete pavements having mineral aggregates similar to that covered by the Topeka decree, the extensive use of non-patented tar concrete pavements of Class C will usually lead to litigation proceedings.

Foundations

Many failures have occurred due to laying tar concrete pavements on weak foundations. Of the more common types of foundations, satisfactory results have been obtained under medium traffic with thoroughly filled and compacted broken stone and tar concrete foundations. Cement-concrete foundations should generally be used.

Construction

Under Class A, two types of pavements will be considered. The most efficient type, as laid in America, has a mineral aggregate which will comply with the following requirements: All of the broken stone or broken slag shall pass a 1¼-inch screen; not more than 10 per cent. nor less than 1 per cent. shall be retained on a 1-inch screen; not more than 10 per cent. nor less than 3 per cent. shall pass a ¼-inch screen.

This aggregate, for small jobs, may be mixed with hot tar cement by hand methods. Usually, however, mechanical heating and mixing plants should be used. In a complete plant for the manufacture of tar concrete, the aggregate is carried by bucket-elevators to rotary dryers, where it is dried and the dust exhausted; from the dryer the aggregate is raised by elevators to storage bins; when required the aggregate is drawn from the bins to a weighing device, and from there deposited into a mixer. Such plants are also equipped with tar cement heating tanks and weighing buckets. A plant of this type should have a capacity of from 800 to 1,000 square yards of 2-inch wearing surface per day. For the type of tar concrete under consideration, it has been found that the tar mixture should contain between 5 and 8 per cent. of tar bitumen.

An important detail of laying is thorough rolling. An even surface and adequate compaction with thorough interlocking of the particles of broken stone may be readily obtained by the proper use of a tandem roller weighing between 10 and 12 tons.

Many methods have been developed for the application of the seal coat of tar. It has been found that seal coats of from one-half to one gallon per square yard of tar cement are distributed most uniformly by the use of hand-drawn gravity distributors followed by a squeegee.

The average cost of this type of tar concrete under normal conditions when laid as a 2-inch wearing course should be from 25 to 40 cents in excess of a water-bound broken stone wearing course of the same thickness.

The second type of tar concrete of Class A to be considered is the two or three course pavements in which each course consists of one product of a crushing or screening plant. The excellent tar slag concrete pavements which have been laid in England since 1903 are of this type. Although used by various municipalities, the largest yardage of this type has been constructed by Tarmac, Limited. One of the Tarmac plants is located at Wolverhampton, adjacent to that of a company producing large quantities of blast-furnace slag. The large molds of slag are transported by small cars from the iron works on a narrow gauge track and dumped near the Tarmac works. These large blocks, while still warm, are broken by sledgehammers to a size suitable for the crusher. After it is crushed and screened into sizes varying from ¼ to 2½ inches it is mixed with a tar compound. Since the slag is warm even after it has been crushed, no heating preliminary to mixing is necessary.

Although in some cases two courses of tar slag concrete are used, usually more than two layers of tar coated slag are employed, as was the case with tar slag concrete pavement laid at Brighton-on-Sea. The details of construction follow: On a well-compacted gravel foundation was spread a scattering of tar-coated slag chips; the bottom layer was composed of 2½ inches of compacted 1¼ to 2½-inch tar-coated slag; the second course consisted of 2 inches of compacted ½ to 1½-inch tar-coated slag; the third course was composed of a thin layer of ⅛ to ⅜-inch tar-coated slag chips, which layer was thoroughly rolled; the pavement was finished by rolling a top dressing of uncoated fine slag screenings.

Tar concrete pavements of Class C, with mineral aggregates similar to the modern Topeka grading, were laid in Pittsburgh, Pa., about 1890. The pavement laid on Lang Avenue has been in service, with only nominal repairs, for the past 26 years. Many similar pavements were constructed in several cities of New England as early as 1885. Since 1913, tar Topeka pavements have been laid in several states throughout the middle west of the United States, and also in cities of New England. Some of the best examples of this type of tar concrete pavement has been constructed with about 8 per cent. of bitumen in the mix and a light seal coat of refined tar.

Accidents on the Job

Instructions issued by Red Cross to Lumbermen in Oregon and Washington

Do not fail to give attention to a wound, even if very slight.

If proper first aid is not available it is safer to expose the wound to the open air than to cover it with unsterilized cloth.

Cut or pull clothing away from a wound.

Never insert anything in a wound and never wash a wound with water.

A wound should be treated with one-half strength tincture of iodine ,which should also be applied for an inch around the edges of the wound.

Fractured bones should be properly secured in place before the patient is moved.

Watch for the nervous effect of shock, and treat it by lowering the head, loosening the clothing, and keeping the patient warm and quiet.

The engineer of York Township, Ont., is drawing up a scheme by which it is hoped to provide adequate drainage for the township with the co-operation of the city of Toronto. The plan is to be discussed at a conference arranged with the works department of the city.

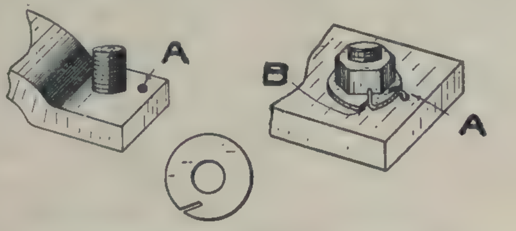
The Saskatchewan provincial government is planning to erect four public schools in the Mennonite colony south of Swift Current.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

A Simple Lock Nut

We were troubled with the nuts loosening up on some of our machinery, due to vibration, or other reasons, and as no lock nut could be used, and it was not feasible to pin the nuts, we had to use some sort of locking device. Necessity is the mother of invention, for, while experimenting, it brought about the highly successful lock washer shown herewith.



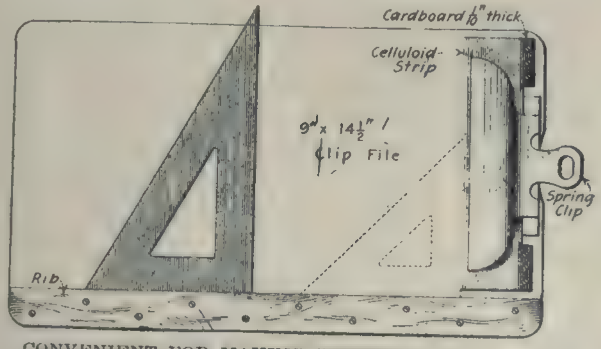
Improvised Washer as Lock Nut.

These sketches are quite clear, but it may be well to say that the hole A should be as generous as reasonable for receiving the lip. Any ordinary washer can be used. The lip B is cut in with a hack saw before applying the washer. This is turned up as shown, and with a punch or drift, the lip A is impressed into the hole.—Engineering and Cement World.

Make Clip File into Handy Sketch Board

Clip files are used on a good many construction jobs to hold paper for taking notes in the field, but one was recently made by the writer on which a triangle could be used, and which proved very handy for making sketches.

As shown in the drawing, the strip along the edge of the board is made of wood about ¼ inch thick. A piece of an old ruler or yardstick will do. This is planed to a straight edge and fastened on with shoe nails or ordinary pins cut the proper length. The thin strip of celluloid at the top is raised about 1/10 inch from the board by putting underneath it a cardboard strip. This allows slipping a piece of paper underneath the edge of the celluloid. The spring clip holds the celluloid firmly down on the paper, so that it serves both as a clamp and as a straightedge. The celluloid strip is, of course, fastened exactly at right angles to the strip along the sides.



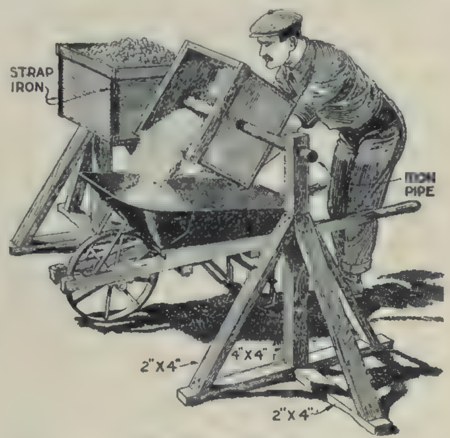
CONVENIENT FOR MAKING SKETCHES OR PLANS OF LAYOUT ON THE JOB

By using a large triangle for long lines and a little one for working close in the corners, as shown on the sketch, the device is converted into a miniature drafting machine. Two copies of pencil sketches can readily be made by using carbon paper.

By R. T. Brown.—Engineering News.

Tip Boxes Measure Materials Economically

In the mixing of concrete the materials should be measured accurately if the best results are to be obtained. Sometimes the wheelbarrow in which the materials are carried to the mixer is used for a measure. To insure accuracy in measuring the materials and also a minimum of wasted time the tip measuring boxes shown in the sketch were made. The boxes are made with the desired cubic capacity and hung, above the centre, on a 1½-in. iron pipe axle. The boxes should be hung high enough to permit a wheelbarrow to be pushed under the bottom without interference. The supports are made of 2 x 4 and 4 x 4 in. pieces, strongly braced. The outfit may be dismantled quickly and reassembled at another location, and the parts are of handy size for loading on a vehicle. In use, the shovelers fill the boxes, and the barrow men wheel their barrows under the boxes, which are promptly filled.—Popular Mechanics.



Measuring boxes.

On March 1, 1917, 4,032 traction engines were in use in Kansas. It is estimated that 6,000 to 7,000 are now in use. The average drawbar horse-power of the traction engines in use is 12.5, which is equivalent to about 25 brake horse-power. The size most commonly used develops about 20 horsepower. The average owner used his tractor 40 to 50 days last year. The majority of Kansas traction engines are propelled by internal combustion engines, using gasoline or kerosene for fuel. Steam traction engines are used to a limited extent for threshing and other heavy belt work.

Building in Montreal

Building in Montreal continues restricted, the permits last month standing at $539,890, a decrease of $83,050 as compared with the corresponding month in 1917. The indications are that the season will not be as good as last year, which was nothing to boast about. The prices of several commodities have again risen, which tends to keep down construction to only the most urgent requirements. Lumber is a notable instance of the increased value of materials, prices now being the highest known. Reports from the province are to the effect that a fair amount of building is proceeding, and in Shawinigan Falls it is active, due to war needs. Important shipbuilding projects are being carried out at Three Rivers and Lauzon, and there is also a scheme for a storage dam at Lake Brule to be built for the Quebec Streams Commission. Schools and churches will, as in 1917, form a substantial part of the work to be done in the province this year.

Personals

Mr. Philip J. Turner, F.R.I.B.A., has been appointed acting assistant professor of architecture at McGill University, and Mr. F. J. Cronk assistant professor of railway engineering.

Mr. Sydney M. Johnson has been appointed by the Stratford city council as temporary engineer during the absence of Mr. A. B. Manson, former city engineer, who is now with the Canadian Engineers.

Engineer James C. Wardrop has resigned from the works department staff of Hamilton, Ont., and is taking up new duties in the office of F. R. Warren, architect. His former fellow-employees presented him with a handsome gold watch as a token of their esteem.

Major Thos. R. Loudon, who went overseas with the No. 1 Construction Battalion as Captain and Adjutant, is now on his way home. Major Loudon, previous to enlistment, was assistant professor of metallurgy in the Faculty of Applied Science and Engineering of the University of Toronto, having taken his degree of B.A.Sc. in 1905.

Obituary

The death occurred recently of Mr. David Webster, of Brantford, Ont., advisory engineer for the city waterworks.

Mr. James Smith, a well-known Toronto architect, who had practiced in this city for about 45 years, passed away recently at his home at the age of 88. Mr. Smith was born in Scotland in 1832 and came to Toronto about 1850. He was responsible for the design of over 90 churches in the city.

Mainly Constructional

East and West—From Coast to Coast

Letters patent have been granted to Fairfax Forgings, Limited, Montreal, capital $1,500,000.

The Lake Superior Dry Docks and Construction Company, Limited, have passed a by-law changing the location of their head office from Sault Ste. Marie, Ont., to Toronto.

A new Sunday school and parish hall is to be built in Brantford, Ont., in connection with Grace Church. It will be of brick and stone construction and will cost about $35,000.

The Leaside Munitions Company propose to double the size of their plant at Leaside, Toronto, and work is about to start on the excavation. The company at present employs 1,500 men.

The waterworks by-laws for the district of North Vancouver, B.C., have been passed by large majorities and the construction of the new water system east of the Seymour River is to be proceeded with.

After the war the city of Hamilton, Ont., will undertake harbor improvements on a large scale. The plans, which cover the whole twenty-mile shore line, are at present in the hands of the engineers, but as yet no report has been given.

Owing to the high cost of building, the Windsor Board of Education has abandoned its intention to erect two new 16-room public schools this year. Instead they plan to use five portable schoolhouses, which will cost approximately $8,000 each.

The $7,000,000 contract in connection with the St. John harbor improvement will include the completion of the drydock, the extension of the breakwaters, the establishment of a steel shipbuilding plant capable of turning out mammoth steamers, and the construction of two 10,000-ton steamships.

The contract for the construction of the nickel and copper refining plant at Deschenes, Que., for the British-American Nickel Corporation, calls for completion of the job before the snow falls. The buildings and machinery will cost over one million dollars. Bate, McMahon & Company have the contract.

The erection of the proposed $400,000 briquette plant in Saskatchewan by the governments of Manitoba and Saskatchewan is being delayed in Ottawa. The Manitoba Government was advised some time ago that the formal official acceptance of the scheme would be forthcoming, but this has not yet been received.

Among the items appearing on the supplementary estimates of the Dominion Government are the following: $175,000 for construction of bridge on the Canada Central Railway over the Peace River, near Peace River crossing; $100,000 for Fraser River improvements; $386,000 for St. Charles River improvements; $250,000 for St. John, N.B., harbor.

Work on the Canadian Northern Railway terminal and repair works at Leaside, Toronto, is now in progress. General offices, a ten-stall roundhouse with turntable on heavy concrete foundations, a 60,000-million-gallon water tank, coaling system, planing mills, freight car repair shop, transfer table, locomotive shop, coach shops, and an ice house are already in course of construction.

The contract for the dam and concrete power house of the new development of the Southern Canada Power Company on the St. Francis River at Drummondville, P.Q., has been let to Morrow and Beatty, Limited, Peterborough. It is proposed to develop 10,000 h.p. at present, but provision is being made in the power house for ultimate development of 18,000 h.p. The work will include about 80 miles of new transmission lines, for linking up parts of the system.—Montreal Gazette.

In connection with an item of $60,495 for the Geodetic Survey, to pay expenses of the survey and demarcation of international boundaries, recently brought before parliament, Hon. Rudolphe Lemieux read a statement by Naulon Cauchon, civil engineer, dealing with the navigation problem. Mr. Cauchon suggested the construction of canal from Cardinal on the St. Lawrence River to Ottawa, so as to avoid the St. Lawrence Rapids. He estimated that this project would cost some fifty million dollars, and was preferable to the Georgian Bay Canal scheme, which could hardly be put through for less than $150,000,000. Mr. Lemieux asked the Minister to draw the attention of the Geodetic Survey to this proposal.

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Unparalleled Scarcity of Houses Why Not Build?

THE scarcity of houses in Toronto, according to prominent real estate men, has not been paralleled in the history of the city. It is almost impossible for a tenant to obtain a house, especially the six-room or seven-room type, which is in a reasonable condition. The rents asked are so high that it is impossible for the average man to live in surroundings where there is sufficient floor space, not to mention good light and proper sanitary condtions. He has to sublet his house, if he is fortunate enough to get one of any kind, and the resulting congestion is greatly detrimental to the wellbeing of the human race.

It is true that there are a large number of houses for sale (as the high cost of building has made it possible to ask big prices), though perhaps not so many as formerly, as the owner has not the same assurance that if he did make a good sale, he could find another house suitable for his family. But there never has been anything but a scarcity of small houses for sale or rent, properties which are in demand by the workman, including the much coveted garden combined with conveniences of a more or less extensive character, within reasonable distance of the centre of the city. Not only are these houses scarce, but the price asked is far in excess of the real value on account of the supply being so much less than the demand. This high price is due also, to some extent, to high land prices, though there has been an adjustment in this direction.

Building has fallen off mainly because of the high cost of material and labour, and to some extent by the tendency to hold up ventures due to the uncertainty of the times. Five years ago a modern eight-roomed solid brick house with hardwood finish could be built for about $4,000. The same building to-day would cost not much less than $6,000 and even at that figure, some of the fittings would be unobtainable. Adding to this a builders profit of $1,000, with the cost of 40 feet of land at $50 a foot, the total is $9,000, which at 6 per cent. is equivalent to a rental of $45 per month, to say nothing of taxes, insurance, maintenance, sinking fund, etc.

Montreal has accepted the flat house as a necessity —a half million people cannot be accommodated in the old roomy way. The Toronto HousingCompany has adopted a similar principle ; their bonds are guaranteed by the municipality, yet even here the pressure of modern prices has been felt and the rentals have been raised twice within a few months. This raising of the rents has been universal, and in many cases they doubtless have been increased much in excess of the sum warranted by the present assessed value, and what is true of Toronto and Montreal is true in more or less degree of many other Canadian towns and cities.

The situation in the United States is very much the same as in Canada, and every encouragement is being given by the governmental authorities to go forward with works of necessity. Secretary of the Treasury McAdoo in a recent statement said " Where it is a question of need—be it on account of sanitary conditions or because without such new construction other operations essential at this time for the welfare of the country would suffer—there is no doubt that the work should be undertaken."

Any building operations which are required to protect the health or provide for the comfortable needs of our people or to supply facilities necessary for the proper conduct of business essential to the successful prosecution of the war should be carried out. Proper housing not only means better health and more comfort, but also a greater fitness for the day's work, which in its turn, means a more vigorous and optimistic prosecution of the war. In view of the very real shortage of housing accommodation in many of our cities, if private capital is not available, municipalities or other governing authorities may well consider the advisability of planning a building campaign.

The Sharing of Profits a Solution of the Wage Problem

THE system of sharing profits among employees assists in certain cases, to a considerable extent, in the solution of the wage problem. It is true that the greatest asset any organization can have is its efficient and contented workmen ; without them no matter what the capitalization, it cannot produce, much less can it show profits at the end of a year's time. Then why should the employees of a plant not receive some share in the profits ?

Would not this tend to keep the monthly wages within reasonable bounds ?

Would it not also,, in many cases, act as a means of encouraging economy; for the sum held over until the end of the year would often otherwise have disappeared monthly with nothing to show for it in the end. The workman agitating for a raise in pay under existing conditions is dependent on what he saves per day in order that he may have a balance to show at the end of the year ; in many instances he receives the increase, but owing to the lack of keeping any record of his expenses he uses up the whole increase in additional expenditure., He soon finds himself in the same position as before. Then he agitates again for another increase. If this increase goes beyond the value of the real work performed, how is the deficit made up ? Every time a wage is raised someone pays for it, either the public by paying increased prices for the product, the labour by producing more, or the employer by cutting down of profits. In general it is the public that pays.

The system of sharing profits enables the workman to look forward. He knows that increased production would generally result in increased profits for the company and consequently his share would be in the end directly proportional to the value of work done in the whole year.

This system of sharing profits among those who really have a good right to it, is used at present by a large number of industries. It has frequently resulted in enormous profits as a result of greatly increased production and it has, besides, practically eliminated the difficulties of the wage problem.

The Storage of Bituminous Coal

SOME interesting data on the storage of bituminous coal is contained in a recent bulletin of the University of Illinois. It is pointed out that in the choice of a storage system the following points should be considered :

(1) Location, size and shape of the available storage ground.

(2) The capacity of the desired installation.

(3) The cost of the plant.

(4) The cost of maintenance.

(5) The cost of operation.

(6) The amount of breakage to be permitted in handling coal.

(7) The way in which the coal is received.

(8) Length of time to be stored.

(9) Climate.

The simplest storage system is the hand operated form, i.e., dumping the coal in a bin from whence it is carried to the furnace.

At the Illinois University, a new system of storage is being carried out. A storage truck carried the coal for storage to a plot of ground where it is dumped. At the storage plot a truck running on the ground first builds up a bed of coal from two to five feet thick building it toward the centre. When this centre becomes too small to provide space for handling the truck the operation continues on top of the first layer, etc.

Dealing with the storage methods as used by the different plants it has been found that coal from 2 inches in size up allowed a flow of air which cooled the pile rather than promoted combustion, and that fine coal prevented air circulation and did not, therefore fire, but wherever the smaller lumps accumulated fires started.

When air cracks in the supporting wall of the pile were plastered with nine parts of coal dust and one part of cement, fires were eliminated.

Another method of storage is under water storage. It prevents the loss of heat value and is not accompanied by deterioration in physical properties, such as slacking. The water retained by the coal upon removal is substantially only that held by adhesion or capillarity.

It is said that, in general, the deterioration of coal stored in piles will be less as the distance from the surface increases. Isolated hot spots sometimes occur which can be readily dug out with a crane, leaving the remainder of the coal in good condition. The temperature of every pile will go up and down, influenced in part by the temperature of the surrounding air and in part by internal heating, but it will be inexpedient to disturb the pile unless the temperature rises to near 200 begrees and is accompanied by the evolution of gas.

In storing the coal in piles, it must be stored low enough to prevent fire ; the depth required will vary with the kind of coal and a V-shaped pile is preferable If the coal has been stored successfully for a year, it is usually past danger.

Need for Gymnastics in Industrial Plants

IN many industrial processes it is hard for an operator, in spite of endeavor to produce good ventilation, moderate temperature and freedom from dust, etc., to continue their work for any considerable time owing to indisposition caused by continued exposure to health racking operations. In many instances the inability to retain labor, by certain prominent firms has been due to the above cause, perhaps more than any other. Often men like their work, but are compelled to give it up and, by the doctors orders, " get ontside."

In order to obviate this evil of reducing vitality and consequently lowering producing power, one firm has established a gymnasium in the plant. In this case only the office staff are required under penalty to report for exercise at a stated hour, the company paying them for the time expended in exercising.

The results obtained have justified the method, in increasing efficiency and tending to lessen the doctor's bill. This system could be a good deal more advantageous if it were applied to the whole plant, instead of only to the office staff. In many cases the operator of a machine in a hot temperature filled with dust and more or less exposed to chemical fumes should receive more attention than at present given. The time loss by the drawing up of a schedule for daily exercises and the additional expense incurred, would be of little consequence if the health of the employees could be improved and thus increase production and profits.

Sanitary Conditions on St. Pierre

A COMMISSION which inquired into sanitary conditions on the River Saint Pierre, Montreal, has reported in favor of an improvement scheme to cost $1,632,997, although it is stated that this could be reduced by adopting tunnel methods on a part of the work under the Lachine Canal. The report on the plan has been prepared by Mr. J. H. Valiquette, engineer in charge of the western division of the city, and one of the members of the Commission.

The plan is divided into five sections, the estimates for which are as follows: 1, River St. Pierre intercepting sewer, tail race of the aqueduct to St. Ambroise Street, $640,000; 2, Pressure conduit attached to River St. Pierre intercepting sewer, to take care of Westmount intercepting sewer, $194,000; 3, Inverted syphon under Lachine Canal, $520,000; 4, Westmount intercepting sewer, $206,478; 5, Deepening of channel outlet, $72,519. It is believed that the scheme will do away with the floods, noxious smells, etc., which have been a menace to public health in the district drained by River St. Pierre. Mr. Paul Mercier, chief engineer of the city of Montreal; Mr. Roy, engineer, St. Pierre aux Lieux; and Mr. Laframbroise, engineer city of Lachine, were among the members of the Commission, of which Mr. J. T. Lafreniere, engineer of the provincial board of health, was secretary.

Ontario Section A.S.M.E.

THE annual meeting of the Ontario Section of the American Society of Mechanical Engineers was held at the Engineers' Club on Monday evening, May 27th. The technical paper for the evening was presented by Mr. J. H. Billings, on "Strength of Cast Iron in bending as affected by variations in cross sections." Following this, the Section was favored with a very interesting and stimulating talk by Mr. Calvin Rice, general secretary, who had arranged to stop over in Toronto on his way back to New York from a visit to some of the Society's branches in the Middle Western States. The results of the election of officers for the local executive were announced as follows:—

Chairman: Professor R. W. Angus, of the University of Toronto.

Secretary: C. B. Hamilton, Hamilton Gear & Machine Company.

Members of Executive: Mr. James Milne, City Hall; Mr. J. H. Billings, University of Toronto; Mr. T. B. Ahara, Canadian Fairbanks-Morse Company.

Fabricated Ships in Great Britain

ONE of the most interesting but least known developments of the present shipbuilding effort in which Great Britain has led the way is that of "fabricated" ships. A "fabricated" ship is a vessel the component parts of which are manufactured in other than shipbuilding yards. These component parts are transported to shipbuilding yards, assembled there, and put together as complete ships.

It is pointed out in the Times that when the State undertook the reorganization of the United Kingdom's shipbuilding industry, the principle of standardization was naturally adopted because in mass production of a specific object the highest possible speed of output is obtainable. A series of standard ships were designed and contracts to build them were given out to the private yards of the country. As supplies of steel and labor increased and promised a margin over and above the requirements of the existing controlled shipyards, the idea was carried a stage further. The fabrication of ships was decided on and the necessary provision made. The aim of the Admiralty Deputy Controller's Department was still further to increase speed of production. As matters stood all the shipbuilding yards, engine factories, and boiler shops were largely occupied with standard ship work. There were, however, many other industrial establishments in the country doing work closely resembling shipbuilding and marine engineering. Among them were bridge building yards and land engine factories. The majority of them were in inland centres and remote from launching water; but, taken altogether, their resources were so great that it was felt that they ought to be used.

Fabrication solved the problem, and a ship was designed the material of which could be satisfactorily fabricated in the bridge yards. It is a bigger vessel than most of the standard ships, and there is not a curved frame in it. Size and weight of unit of construction are limited, so that transport is easy and powerful gear for placing it in position is unnecessary. To avoid the same difficulties as regards machinery supply, geared turbines have been adopted instead of reciprocating engines. Every part of the complete ship can, in fact, be fabricated in inland establishments selected near the steel mills which have never done ship or marine engine work, and can be transported by ordinary means to the seaboard. With all the slips in private yards filled it was necessary to look elsewhere for sites for assembling yards. The national shipyards on the Bristol channel were laid out for the purpose, and private undertakings of the same character exist or are projected with the concurrence of the Admiralty elsewhere. The bulk of the labor is unskilled, but is, however, being trained in the use of pneumatic riveters and caulking tools, and will be (already it is in a large number of instances) sufficiently expert to put the assembled fabricated ships together.

The fabrication of the material of ships and engines has now been organized over a considerable area, local committees being responsible in certain districts for definite deliveries of a ship, or a number of ships, in specified periods. Moreover, fabricated ships are taking shape in several assembling yards. Before long, vessels of the type should represent a very considerable addition to the tonnage output.—Weekly Bulletin.

Berms for Highway Curves

The California Highway Commission has, according to "Good Roads," undertaken to "daylight" all dangerous curves. When the curve passes around a hill there is usually a high embankment which prevents the driver of a car from seeing what is coming around the curve from the other direction. The plan is to excavate a berm or bench on the slope at the inside of the curve, at a height of about 3 feet above the roadway, which is taken to be a little below the line of sight of the driver. Where the work is difficult owing to the nature of the material, the berms are made 5 or 6 feet wide, but it is found preferable to use berms 12 feet wide. On a curve of 10 feet radius a 5 foot berm will enable motorists to see each other when 95 feet apart. If the berm is increased to 12 feet this range of vision is 115 feet or 124 feet along the road. In this way the danger of blind curves is materially reduced and if cars are travelling at moderate rates there is plenty of time to avoid a collision.

Engineering Institute of Canada

The Bill amending the charter of the Canadian Society of Civil Engineers has received the assent of the Governor-General. Henceforth the name of the Society will be "The Engineering Institute of Canada."

Institute for Chest Diseases in Vancouver

The campaign staged by the Rotary Club, of Vancouver, B.C., a few weeks ago has,by the united efforts of the members, together with strong support from the citizens of Greater Vancouver, now attained its objective, and the public may definitely look forward to having established in their city the Rotary Institute for Chest Diseases. The Institute will be erected, fully equipped and maintained for the period of one year out of the funds on hand, when the Rotary Club proposes to present the established institute to the citizens. With this end in view, and through the hearty co-operation of the mayor and aldermen of the City of Vancouver, it has rightly been decided to erect the institute, on city property in the heart of the city, where the main field of labour lies. The chosen site is a plot of ground at present partly occupied by what once was the City Hospital, but now serves as the City Relief Department, and is situate on the south side of Pender street between Cambie and Beatty street.

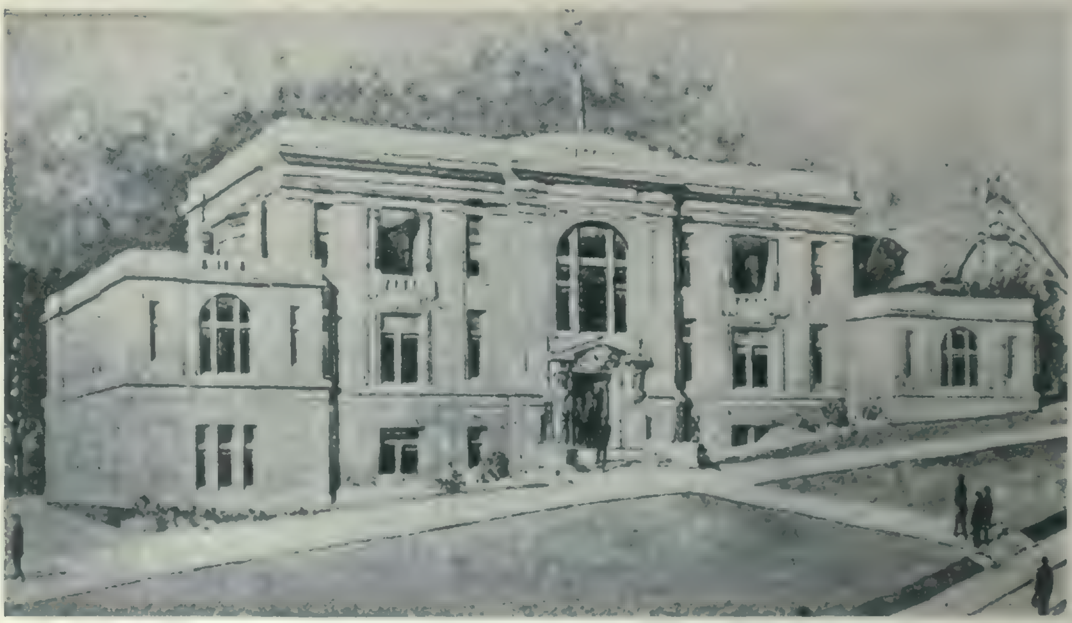
The work of this Rotary Institute for Chest Diseases, will be far reaching, but of single purpose, namely, the fight against tuberculosis, while the chief purpose of the building is to provide a modern and scientifically equipped tuberculosis clinic where the best of medical science will dispense diagnostic examination and medical advice free of charge to all, and as such will serve as a clearing house for hospitals and sanitaria ; also the clinic will serve as an educational bureau, not only for sufferers, but for medical men and nurses, and for the enlightenment of the general public. The institute will not be a hospital or sanatarium, but rather a preventorium, and as such much effort will be directed towards safeguarding the children from contact with and development of the disease, with which work in view the building will contain an "Al fresco" day school where children with tubercular tendencies will be under observation and medical treatment, while at the same time obtaining their daily education, removed from the public schools in the interests of the other children.

Yet another branch, and that an important one, will be the visitation of incipient cases in their homes by a staff of visiting nurses and the "follow up" of patients discharged from the sanatarium, all of which, together with the complete system of records and statistics, would open up a valuable community service heretofore little catered for in any western city—a work which the authors and the recipients may well be proud of.

In designing the institute the architect has endeavored to delineate both outwardly and internally the functions required of such an institute in order that the naturally reticent sufferer or self-respecting visitor may not find an imposing structure nor yet a forbidding one, but rather a substantial, retiring dignity combined with sufficient wealth of detail to invite rather than repel. At the same time no one can lose sight of the times in which we live, and while this institute, with "life conservation" as its raison d'etre, is one more closely allied to war work than at first one might suppose, here again the designer has chosen to carry out the structural, as also the decorative, with a maximum call upon materials not only to be procured locally, but most easily to be spared by the requirements of war, so that we find clay products figuring largely in the building. In the same thought comes the question of economy, which to-day must be considered the corner stone of all architectural work.

Description of the Proposed Institute

The building measures approximately 95 feet from east to west by 40 feet over all in depth, and is for the most part two stories and basement, but not in its



Vancouver Rotary Institute for Chest Diseases.

entirety, as large airing balconies displace the upper storey of the eastern and western wing, while the rising gradient eclipses the right-hand portion of the basement, which it is not proposed to excavate.

The exterior has been treated on the semi-classic lines, and will be rendered in speckled buff pressed brick, with trimmings of Monarch art stone (known in the east as Roman stone).

The entrance, in the centre, facing Pender street, lends itself to the grade and opens on to a vestibule set three or four steps below the main floor. The main floor provides for exhibition and waiting room, measuring approximately 27 feet by 16 feet, fitted with lecture platform blackboard and roller screen for lantern exhibits. Leading to the right (west), are arranged on either side of the corridor suites of waiting rooms, dressing rooms, toilets, etc., for male and female respectively, each suite being intercommunicating, and leading to medical examination rooms. These examination rooms will also be intercommunicating, to allow of speedy administration by the medical examiners. Adjacent to the examination rooms are also located the laboratory and pharmacy. Leading to the left (east) on entering is located a complete suite of rooms for x-ray examination, comprising local waiting room, machine room, table and floroscope room; these again are intercommunicating and lead forward to a developing room and filing room for negatives. In this wing also (to the north) is located medical superintendent's administration and secretarial offices.

On ascending the central stairway the upper floor is divided approximately into three units, the central southern portion being given up entirely to the school room. This school room is arranged with a large bay window to the south, while there is also overhead light around the four upper walls for natural ventilation. This school room will be used when the weather is at all inclement ; at other times the school children will meet on open air balconies to the east and west. It has been arranged to have separate entrances for boys and girls leading directly to the school quarters from the south side of the building, to avoid the necessity of the children using the main entrance to the institution.

To east and west of the upper landing are arranged sun parlours or rest rooms for male or female visitors under treatment. Each room is centrally located, has an open fireplace in the north wall, windows on three sides and each opening directly on to a large balcony measuring approximately 38 feet by 14 feet, in addition to a small north balcony. Adjacent to each rest room is a diet kitchen, served by dumb waiters from the basement ; these rooms to be equipped to serve light nourishment only, as occasion demands. Separate toilet rooms have been arranged on this floor for boys, girls, male and female adults, these are located on the south-east and south-west corners, and are cut off by ante-corridors, opening off local entrances to the school, and from the sun rooms. A small bedroom suite for a utility man, who will attend to the day visitors, completes the upper floor.

In the basement, which occupies about three fourths of the building space, there will be janitor's suite, kitchen, service store rooms, refrigerators, etc., with the balance of the space taken up by boiler and fuel space for hot water heating.

The interior finish will be on simple lines, all walls being plastered with hard wall plaster, and while the floors in the entrance and main corridors will be of terrazzo, and that of the toilet rooms of tile, the majority of the floors will be finished with linoleum cemented onto the concrete, and finished flush with margins and sanitary skirtings of composition. The doors, windows and trims will be plainly detailed of B.C fir construction, painted and enamelled.

All electrical work for light, power and telephones will be in conduit. Contract tenders will shortly be invited from local contracting firms, and construction will commence without loss of time. It is estimated that the building will cost approximately $40,000, while the equipment to be installed will cost from $10,000 to $15,000.

The building has been designed by Mr. James A. Benzie, architect, of Vancouver, who is at present preparing the working drawings and specifications.

An attractive bridge design on account of its simplicity.

Revised Code for Reinforced Concrete Structural Designs

A REVISED code for the design of reinforced concrete structures has recently been prepared by Mr. H. D. Appleby, designing engineer, U. S. Bureau of Yards and Docks, and Messrs. E. C. Sherman, I. Maguire, I. Michaelson and E. M. Webster, Bureau Engineers. The following details appear in Engineering and Contracting:

DETAILS OF CONSTRUCTION

Protective Covering.—The minimum thickness of concrete or mortar for protection of metal against corrosion shall be 1 inch.

The minimum thickness of concrete or mortar for protection of metal against fire shall be as follows:

	Inches.
Columns and girders	2
Floor beams	1½
Slabs	1

The above dimensions are from face of rod to face of concrete. To determine distance from face of concrete to center of steel add half the diameter of the rods to the above dimensions.

All corners and edges of columns, girders, and beams shall be either beveled or rounded.

Splicing Reinforcing Material and Joints in Reinforced Concrete Construction.—Where tension or compression reinforcements are spliced they shall be lapped on the basis of the bond stress and the stress in the bar at the point of splice, or a connection shall be made between the bars of sufficient strength to carry the stress.

In columns, small rods (¾ inch and under) shall be lapped as specified above, and structural shapes or heavy bars shall be properly spliced and provided with bearing plates at foundations; rods above ¾ inch shall be squared and butted in sleeves, and in foundations the bars shall be carried into the footing a sufficient distance to transmit the stress of the steel to the concrete by means of the bond resistance.

Stopping Points.—Whenever it is found impossible, owing to the magnitude of the work, to cast the entire structure in one operation, the following locations shall govern for stopping points for the respective parts; Joints in columns shall be flush with bottom surface of girders, and in flat slab construction at the bottom of the flare of the column head; joints in girders shall be at center of span, unless a floor beam intersects the girder at this point, in which case the joint shall be offset a distance equal to at least twice the width of the beam; joints in floor beams and slabs shall be at the center of the span. All joints shall be perpendicular to the axis or surface of the member jointed. In every case planes of cleavage caused by stoppage of work shall be provided with offsets and extra reinforcement, if necessary, to develop the full designed strength.

General Assumptions.—Slabs and floor beams shall be designed to support the total dead and live loads; girders shall be designed to support the total dead load and 80 per cent. of the live load and columns shall be designed for the total dead load and 75 per cent. of the full live load, except as noted below. For roof loads the full live load shall be used. In storehouses 80 per cent. of the live load shall be used on columns only; beams and girders shall carry full live load. Proper provision shall be made for the dynamic effect of live load, where same justifies consideration, by the addition of a percentage. In special cases, where conditions justify, girders and columns shall be designed for 100 per cent. of the live load in addition to the total dead load.

Span Lengths of Slabs, Beams and Girders, and Column Lengths.—The span lengths for slabs, beams and girders, simply supported, shall be taken as the distance from center to center of supports with a maximum span length of the clear distance between supports plus the depth of girder or slab. For continuous or restrained beams the span length shall be taken as the clear distance between faces of supports exclusive of brackets. The length of column shall be taken as the maximum unsupported length.

Spacing of Rods.—The lateral spacing of parallel bars shall not be less than 3 diameters from center to center and not less than 2 diameters from side of beam to center of rod. The clear space between 2 layers of bars shall not be less than 1 in. The use of more than 2 layers will not be allowed unless special reasons make same imperative, in which case special provisions shall be made for tying together.

Columns.—For columns reinforced longitudinally and with or without spiral hooping, the ratio of unsupported length of column to its least over-all diameter shall not exceed 15. For columns reinforced with spiral hooping only, this ratio shall not exceed 10. In no case shall the least over-all diameter be less than 12 inches. The protective covering over the steel shall be 2 inches. The effective area of hooped columns shall be taken as the area within the perimeter inclosing the spiral. Longitudinal reinforcement shall not exceed 4 per cent. nor be less than 1 per cent. of the effective area. The total amount of spiral or hooping reinforcement shall not be less than 1 per cent. of the volume of the column, inclosed. The clear spacing between hoops shall not exceed 1/6 of the diameter of the inclosed column, and shall in no case be greater than 2½ inches.

Where structural steel shapes are used for reinforcing columns, they shall be provided with lattice bars or plates to tie them together, no dependence being placed on the concrete for this purpose. All splices, connections, etc., shall be designed in strict accordance with structural steel practice.

Reinforcement for Shrinkage Temperature Stresses.—Reinforcement should be equal to about one-third of one per cent. and should be of a form to develop high bond resistance. It shall be placed near exposed surface and shall be well distributed.

T-Beams.—Where a floor slab and beam are built as a monolithic structure, the total width of that portion which is used as the flange of the T-beam, shall not exceed the width of the stem plus eight times the thickness of the slab; also it shall not exceed four times the width of the stem. For isolated beams the width of the flange shall not exceed three times the width of the stem. In all cases the total width of flange shall not exceed one-fourth of the length of the span.

Maximum Allowable Unit Stresses and Ratio of Moduli of Elasticity.—The allowable unit stresses shall be the percentage given herein of the ultimate strength of the particular concrete which is to be used, as shown in the following:

(In pounds per square inch)

Aggregate	1:1:2	1:1½:3	1:2:4	1:2½:5	1:3:6
Granite, trap rock, gravel, hard limestone and hard sandstone	3,000	2,500	2,000	1,600	1,300
Soft limestone and sandstone	2,200	1,800	1,500	1,200	1,000
Cinders	800	700	600	500	400

ALLOWABLE UNIT STRESSES

Piers and Foundations.—Plain bearing on a concrete surface of at least twice the loaded area, 35 per cent. of compressive strength. Plain bearing on other surfaces, 25 per cent. of compressive strength. Axial compression in plain concrete pier, the length of which does not exceed four diameters, 22.5 per cent. of compressive strength.

Slabs, Beams, and Girders.—Compression in extreme fibers of concrete, 32.5 per cent. of compressive strength. Compression in extreme fibers of concrete at supports of continuous beams, 37.5 per cent. of compressive strength. Vertical shearing stress, horizontal bars only and without web reinforcement, 2 per cent. of compressive strength. Vertical shearing stress, bent-up bars only and without vertical stirrups, 3 per cent. of compressive strength. Vertical shearing stress, combination of bent-up bars and vertical stirrups fastened securely to the bars and spaced horizontally not more than one-half of the depth of the beam, 5 per cent. of compressive strength. Punching shear with diagonal tension provided for, 6 per cent. of compressive strength. The unit shearing stress shall be computed by the formula $v = V/bjd$. In providing for diagonal tension the web reinforcement shall be designed to take two-thirds of the total vertical shear.

Bond Stress.—Bond between concrete and plain bars, 4 per cent. of compressive strength. Bond between concrete and deformed bars, 5 per cent. of compressive strength. Bond between concrete and drawn wire, 2 per cent. of compressive strength.

Columns.—Columns with longitudinal bars held by bands, the bars being not less than 1 per cent. nor more than 4 per cent. of the area of the column core, the bands being not less than ¼ inch in diameter and approximately 12 inches on centers, shall have a unit stress on the concrete core not to exceed 25 per cent. of the compressive strength. Columns with close hoops or spirals only, of not less than 1 per cent. of the column core and spaced not more than one-sixth of the diameter of the column core nor more than 2½ inches on centers, shall have a unit stress on the concrete core not to exceed 27 per cent. of the compressive strength. Columns with close hoops or spirals and with longitudinal bars all within the limits specified above, shall have a unit stress on the concrete core not to exceed 33-1/3 per cent. of the compressive strength, and in no case to exceed 800 lbs. per square inch.

Steel Reinforcement.—The tensile or compressive stress in steel shall not exceed 16,000 lbs. per square inch. Steel in compression shall be considered to be stressed "n" times the stress in the adjacent concrete, where "n" represents the ratio of the modulus of elasticity of steel to that of concrete, as given below:

MODULI OF ELASTICITY

In designing reinforced concrete, the ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete shall be taken as—

Forty, when the compressive strength of the concrete does not exceed 800 lbs. per square inch.

Fifteen, when the compressive strength of the concrete is greater than 800 lbs. per square inch and less than 2,200 lbs. per square inch.

Twelve, when the compressive strength of the concrete is greater than 2,200 lbs. per square inch and less than 2,900 lbs. per square inch.

Ten, when the compressive strength of the concrete is greater than 2,900 lbs. per square inch.

STANDARD NOTATION

Rectangular Beams

The following notation shall be used:

f_s = tensile unit stress in steel.
f_c = compressive unit stress in concrete.
E_s = modulus of elasticity of steel.
E_c = modulus of elasticity of concrete.
$n = E_s/E_c$.
M = moment of resistance, or bending moment in general, in inch-pounds.
A = steel area in square inches.
b = breadth of beam in inches.
d = depth of beam, to center of steel, in inches.
k = ratio of depth of neutral axis to effective depth d.
z = depth of resultant compression below top.
j = ratio of lever arm of resisting couple to depth d.
$jd = d - z$ = arm of resisting couple.
p = steel ratio (not percentage).
w = load per lineal foot of slab or beam.
l = length of span in feet.

T-Beams

b = width of flange.
b' = width of stem.
t = thickness of flange.

Beams Reinforced for Compression

A = area of compressive steel.
p' = steel ratio for compressive steel.
f'_s = compressive unit in stress in steel.
C = total compressive stress in concrete.
C' = total compressive stress in steel.
d' = depth to center of compressive steel.
z = depth of resultant of C and C'.

Shear and Bond

V = total shear.
v = shearing unit stress.
u = bond stress per unit superficial area of bar.
o = circumference or perimeter of bar.
Σ_o = sum of the perimeters of all bars.

Columns

A = total net area.
A_s = area of longitudinal steel.
A_c = area of concrete.
P = total safe load.

DESIGN

Beams and Slabs.—Continuous spans: Slabs 1/12 wl^2 at center and over supports. Beams 1/12 wl^2 at center and over supports for interior spans; 1/10 wl^2 at center and over support for end span of a series. Beams and slabs ⅛ wl^2 over center support for 2 spans only. $1/10\ wl^2$ at center of spans for 2 spans only.

At ends of continuous beams the amount of negative moment depends on the form of construction.

No smaller moments than the above shall be allowed over supports even if more reinforcement is put in at the center of the span.

Steel on compression side may be considered as acting.

Ends free and simply supported.

Beams and slabs $\frac{1}{8}\ wl^2$ at center.

Slabs Supported Along Four Sides and Reinforced in Two Directions.—Square slabs: One-half the load shall be considered as carried by each system of reinforcement.

Rectangular slabs: If w is the total load per square foot, l and l_1 are the length and breadth of panel, respectively, in feet and $r = l/l_1$, then the load per square foot carried by the transverse system of reinforcement shall be taken as—$wl^4/(l^4 + l_1^4)$ or $wr^4/(1+r^4)$and the load per square foot carried by the longitudinal system shall be taken as—$wl_1^4/(l^4 + l_1^4)$ or $w/(1 + r^4)$.

Assuming these unit loads as determined above for (a) and (b), two-thirds of the calculated moments shall be assumed as carried by the center half and one-third by the outside quarter of each system of reinforcement.

Spacing Stirrups.—Stirrups should be spaced by the formula:

$$s = \frac{16000a}{(v-40)b}$$

for 1:2:4 concrete where—

v = unit shearing stress.
b = breadth of beam in inches.
s = distance between stirrups in inches.
a = cross-sectional area of 1 stirrup in square inches.

The unit shear on cross section should never exceed 120 lbs. per square inch.

If main reinforcing rods are bent up for web reinforcement, the points of bending shall be calculated. For this purpose the method used for designing cover plates of built-up steel girders is applicable, the formula for uniform load on a simply supported beam being:

$$\frac{L'}{L} = \sqrt{\frac{a'}{A}}$$

where L' = length of horizontal part of bent rods.
L = span length.
a' = area of bent rods.
A = total area of reinforcement.

For continuous beams, bending up at the ¼ points will be satisfactory, but sufficient steel must be placed top and bottom, on each side of the quarter points, to take care of the stresses resulting from irregular loads.

Girders and Beams.—In girders and beams use 1:2:4 concrete and the following maximum unit stresses:

Tension in steel, lb.	16,000
Compression in concrete, lb.	650

This gives—
$kd = 0.3786\ d$
$jd = 0.8738\ d$
$M = 107.5\ bd^2$
$A = 0.0077\ bd$

Piers, Seawalls, Etc.—Outside work, such as piers, wharves, sea walls, etc., shall not exceed the following unit stresses used in their design:

Tension in steel, lb.	12,500
Compression in concrete, lb.	600

This gives—
$M = 108.0\ bd^2$
$A = 0.01\ bd$
$kd = 0.418\ d$
$jd = 0.861\ d$

The Flat Slab Floor Without Beams.—Symbols for square panels:

l = distance center to center of columns in feet measured along the side of a square panel.
C = diameter of column capital in feet measured on the bottom surface of a slab or dropped panel.
S = side of square dropped panel in feet.
B = width of any band of rods in feet.
W = sum of live and dead loads in pounds per square foot.
M = bending moment in foot-pounds.
d = effective depth of slab in inches.
D = effective depth of dropped panel in inches.
t = total thickness of slab in inches.
T = total thickness of dropped panel in inches. Other symbols are those used in the Standard Notation.

Four-Way System with Dropped Panel.—The following formulas shall be used in design:

$S = 0.42l$
$C = 0.225l$
$B = 0.42l$
$d = l\sqrt{w/61}$ on basis of moment, for w not greater than 440 lb., and $p = 0.77$ per cent.
$d = wl/1{,}278$, on basis of shear, for w greater than 440 lb.
$D = 1.5d$
$t = d + 1.5$ in.
$T = D + 2$ in.
Total negative M at column (in any direction) $= 0.032wl^3$.
Positive M at middle of bands $= 0.012wl^3$.
Negative M over middle of side bands $= 0.009wl^3$.

The above proportions for S, C, B, and D make it necessary to solve only two of the other formulas. Assume a total thickness, t, to determine a tentative value of w. Solve for d and determine the correct value of w. D then becomes 1.5d. Find the positive moment at the middle of the bands from the formula positive $M = 0.012wl^3$. From the moment thus found find the amount of positive steel required at the middle of each band. Carry this same amount of steel over the column in each band, which will take care of the total negative moment at the column. Finally, take three-fourths of this positive steel and distribute it in the top of the slab over the side bands and over the central half of the panel to take care of the negative moment at the middle of the side bands.

Two-Way System with Dropped Panel.—The following formulas shall be used in design:

$S = 0.4l$
$C = 0.225l.$
$B = 0.4l.$
$d = l\sqrt{w/50}$ on basis of moment, for w not greater than 576 lb. and $p = 0.77$ per cent.
$d = wl/1{,}200$ on basis of shear, for w greater than 576 lb.
$D = 1.25d$, for $p = 1$ per cent.
$t = d + 1.5$ in.
$T = D + 2$ in.
Negative M at column for each band $= 0.032wl^3$.
Positive M at middle of side band $= 0.017wl^3$.
Negative M over middle of side band $= 0.015wl^3$.
Positive M at middle of center band $= 0.008wl^3$.

Details of Construction.—The above formulas apply to square panels and uniformly distributed live loads. For heavy concentrated loads special provision will have to be made by the use of beams or girders.

The diameter of the column capital shall be considered to be measured where its vertical thickness is at least 1½ inches, provided the slope of the capital below this point nowhere makes an angle with the vertical of more than 45 degrees.

Points of inflection on any line joining two column centers may be taken as one-fifth of the clear distance on that line between the perimeters of the column capitals and measured from the perimeters.

If the length of end panels is made equal to 0.85 of the length of the interior panels it will not be necessary to compute the moments for end panels, and the same distribution of steel may be used in both end and interior panels.

Punching shear at the face of the column shall not exceed 120 lbs. per square inch.

The total thickness of the slab shall never be less than 6 inches.

Rectangular Panels with Unequal Sides.—The following applies to both the four-way and the two-way systems:

In determining the thickness of slabs and dropped panels the factor l, occurring in the formulas for thickness, shall be the longest side distance center to center of columns.

In determining moments in side bands and center bands the factor l, occurring in the formulas for moments, shall be the distance center to center of columns parallel to the band in question.

In determining moments in diagonal bands the factor l, occurring in the formulas for moments, shall be the average of the two side distances center to center of columns.

Well Known Contractor Gone

Mr. George Fee, an old railway contractor, died at his residence, Westmount, on May 25th. Mr. Fee retired some fifteen years ago from the firm of George Fee & Company, railway contractors, who completed a section of the C.P.R. in Ontario in 1885. He was the first mayor of North Bay, Ont.

Parliament Buildings Contracts

The contract for the steel casement windows for the Parliament Buildings, Ottawa, has been awarded to the Trussed Concrete Steel Company of Canada, Ltd., through Mr. G. B. Reynolds, the company's Montreal engineer and sales manager. The Montreal office has also closed contracts for the reinforcing concrete steel according to the Truscon system for the munitions plant of the P. Lyall & Sons Construction Company, Limited, to be erected at Longue Pointe, Montreal, a building 576 x 175 feet; and for the reinforcing steel for the Delorimer Academy, Montreal, the general contractor for which is Mr. O. Archambault.

Arbitration Completed

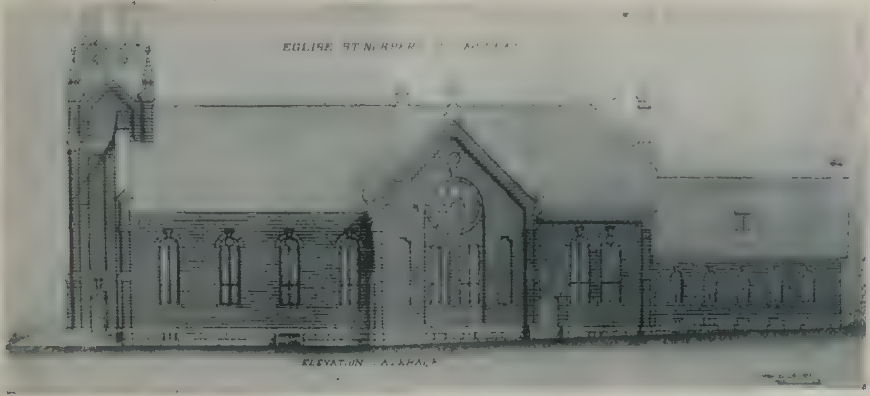
The arbitration between the Cook Construction Company and the City of Montreal on the construction of the aqueduct and the break in the water conduit is now concluded. The contractors made certain claims and the city put in a counter claim. The evidence of experts from Canada and the United States occupied many days, and the arbitrators, Messrs. J. M. Fairbairn, W. F. Tye and A. Geoffrion, K.C., visited the conduit.

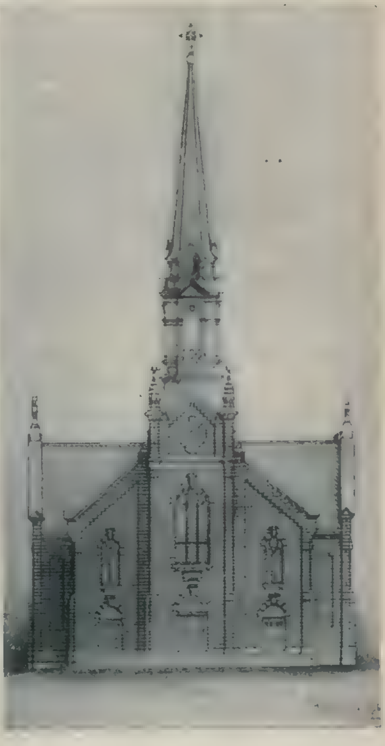
The Quebec Government is adhering to its policy of disallowing by-laws guaranteeing loans to companies by town councils, where, in its opinion, this is detrimental to the interests of the inhabitants. The Government has declined to sanction by-laws passed by the Council Pointe-aux-Trembles, P.Q., guaranteeing a stock issue by a company to build a cement plant and by another company to build workmen's houses.

Mr. E. Gill, town engineer of Sorel, P.Q, has drawn plans and specifications for improving the town aqueduct and installing new pumps to replace the existing plant. One pump will have a capacity of 1,500,000 gallons to be used for the ordinary town supply, and another of 3,500,000 gallons for fire fighting purposes. A new filter is also to be installed at a later date.

Church of St. Norbert du Cap Chat

The illustrations herewith are reproductions from architect's drawings of the church of St. Norbert du Cap Chat, Conte Gaspe, Que. The church was erected by Jos. Collin, general contractor (entrepreneur general). The work was commenced in the spring of 1917, but owing to the rigor of the past winter season, had to be discontinued, the masonry at this time standing a few feet above the portal door. The church will be completed this autumn. The cost of construction is about $60,000, not including interior carpentry.





The Design of Public Highways

By Mr. Charles H. Moorefield*

MANY factors are to be considered in planning the improvement of almost any public road, let alone a system of roads for an entire community. Almost daily, we are in receipt of the query, "What kind of roads are cheapest and best for my community to build?" Replies necessarily must be more or less disappointing, because the information in the letters of enquiry seldom is sufficient to warrant us in offering any very definite advice.

Road design is, in general, a local problem, the proper solution of which involves (1) the safety, convenience, and comfort of those for whose use the road is intended; (2) the amount of funds available for the improvement; (3) the relative availability and cost of various road-building materials that might prove suitable for constructing a road of the general character desired.

In other words, the aim in planning public road improvements should be (1) to furnish the taxpayers the kind of public road accommodations they need and are able to pay for, and (2) to attain this purpose at the least possible ultimate cost to the public treasury.

In order to accomplish this the person who designs a road must be thoroughly familiar with local conditions, and must possess the judgment necessary to weigh the importance of the various factors that should be considered.

From what has been said it is evident that the most to be hoped from a general discussion of road design is a presentation of facts and suggestions that may serve in a measure to guide the judgment in adapting the design of a particular road to local conditions. Therefore, no attempt will be made to state definite and exact rules for designing roads to suit conditions. The most important features of the problem will be taken up separately and discussed with a view to showing the variations in current practice and the influence of some special conditions with regard to each feature.

Figures 1, 2, and 3 are typical cross-sections, illustrating the design of various types of roads. The cross-sections are intended to cover a wide range of practice, and the following remarks regarding various features of the design are intended to aid in applying the information furnished by both the table and the cross-sections.

Drainage

Every person living in a humid climate is familiar with the action of water in converting clay into mud and in causing all kinds of soils, except sand, to give way when a load is applied. But in spite of this widespread knowledge, inadequate drainage probably is responsible for more road failures than any other cause.

The subject of road drainage is too broad to be discussed adequately in an article of this kind, but the Office of Public Roads and Rural Engineering has issued several bulletins dealing with this subject. Copies of these may be secured by purchase from the superintendent of documents, Government Printing Office, Washington, D.C., or in cases where the department's supply has not been exhausted copies may be secured free by addressing the Division of Publications of the department.

Selection of Surface Type

There are some seven or eight well-recognized types of road surface, each of which is well adapted to certain sets of conditions. Most of these types are illustrated roughly by means of the cross-sections shown in Figs. 1, 2, and 3. Before discussing the question of how to select the proper type of surface for a particular road it seems desirable to point out at least some of the limitations to which the different types are subject. For complete discussions of the various types the reader is referred to other publications of this department that have been prepared from time to time.

The cross-sections indicate, in a general way, the range of dimensions in good design practice, with each type of surface. There are many special circumstances, however, that may make it desirable to modify the cross-sections entirely outside of the limits shown. In the peninsular section of Florida, for example, many brick roads are being constructed with no other foundation than the natural sandy soil of the roadbed, and, under such favorable climatic conditions, they may prove satisfactory for many years. The so-called monolithic type of brick pavement is another modification which is being used satisfactorily in some localities. In constructing this latter type the sand bedding is omitted entirely, and the bricks are laid directly upon the green concrete foundation.

The typical design for concrete roads is sometimes modified by the introduction of steel reinforcement, which is intended to prevent objectionable cracks from forming in the pavement. Also, where first-class concrete materials are scarce, the pavement may be constructed in two courses, so that an inferior grade of aggregate may be used in the lower part of the concrete.

Bituminous roads may be constructed either by the mixing or penetration method. When the mixing method is followed the surface is called bituminous concrete, and when the penetration method is followed the surface is called bituminous macadam. A variety of bituminous materials are used in connection with either method. For these reasons neither the method nor the bituminous material is indicated on the typical cross-section drawing.

The method of constructing water-bound macadam roads does not vary over a very wide range in good practice, but the quality of the stone used may affect the efficiency of such roads to a considerable extent. Water-bound macadam, after being opened to traffic, frequently receives a surface treatment of bituminous material and stone chips or pea gravel. Surface treatments of this kind generally are classed as maintenance work, because their purpose is to allay dust and at the same time permit the substitution of continuous maintenance for periodic renewals. But surface treatments really change the nature of the surface and adapt it to a class of traffic different from that for which plain water-bound macadam is adapted.

Gravel, sand-clay, and earth roads must all frequently be modified from the typical designs shown, so as to adapt the construction to the materials available or the conditions encountered.

In order to select the type of surface best adapted to the needs of a particular road it is necessary to consider (1) the class of traffic to which the road will be subjected, and (2) to compare the estimated ultimate costs of the different surface types which would be capable of withstanding that particular class of traffic in a manner satisfactory to the community. A practical way to proceed in making the selection would be:

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1. Estimate the traffic importance of the road in question, as indicated in connection with table of design and cost data.

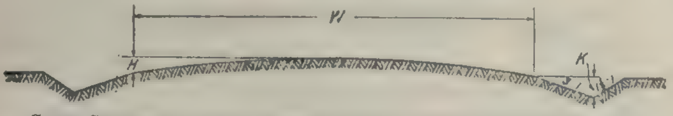
2. Eliminate from consideration all surface types, except those which experience has shown to be well adapted for the traffic in question. To do this requires, of course, a study of the efficiency records of existing improved roads which fall in the same traffic class. Unfortunately, the number of roads for which accurate traffic and efficiency records have been kept is not sufficient to warrant very definite conclusions to be drawn, covering all classes of traffic and types of construction. The following summary supplies about as definite information on this point as can be drawn from available records:

(a) Earth roads, when properly maintained, are satisfactory in dry weather for a light volume of all kinds of highway traffic.

(b) Sand-clay roads are the same as earth roads, except that the surfacing material has been selected carefully with a view to increasing the stability of the surface in both wet and dry weather. They are satisfactory for a moderate traffic of horse-drawn vehicles and a light traffic of automobiles. They seldom are satisfactory for even a light traffic of heavy trucks unless the roadbed material is very stable.

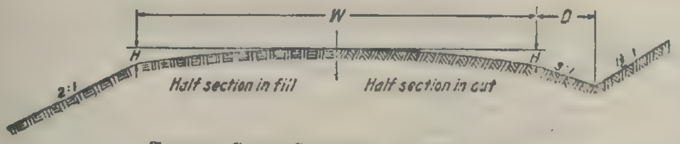
(c) Gravel roads, when well built, are satisfactory for a heavy traffic of horse-drawn vehicles, a light traffic of automobiles, and a light traffic of heavy trucks.

(d) Water-bound macadam roads are adapted to the same general character of traffic as gravel roads.



Cross Section of Earth Road Completed With Grading Machine.

W should be not less than 20 feet. *K* usually varies from 12 inches to 18 inches and depends on width of road and amount of water to be carried; *H*, crown, varies from one half inch to the foot for level grades to 1 inch to the foot for grades of 5 per cent or over.



Typical Cross Section of Earth Road.

W should be not less than 20 feet. *D* varies from 2 feet to 6 feet, depending on rainfall and grade; *H*, crown, varies from one-half inch to the foot for level grades to 1 inch to the foot for grades of 5 per cent and over.

Fig. 1.

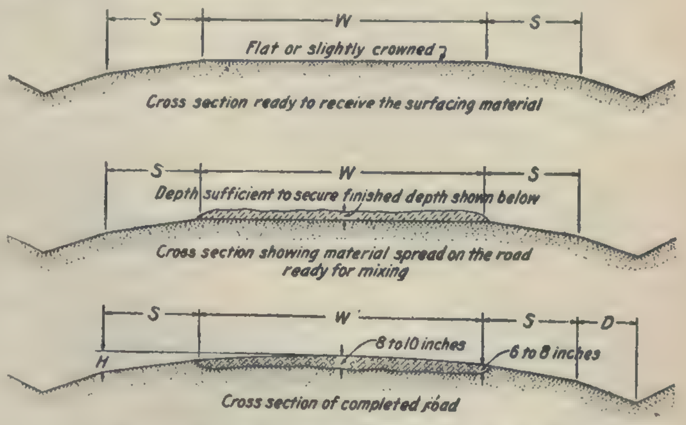
(e) Surface-treated macadam roads are adapted especially for a heavy traffic of automobiles. They also are satisfactory for a light traffic of horse-drawn vehicles and a moderate traffic of heavy trucks.

(f) Bituminous roads are suitable for heavy traffic of both automobiles and horse-drawn vehicles and a moderate traffic of heavy trucks.

(g) Concrete roads are adapted to the same general class of traffic as bituminous roads, and generally are capable of withstanding the traffic of somewhat heavier vehicles without injury.

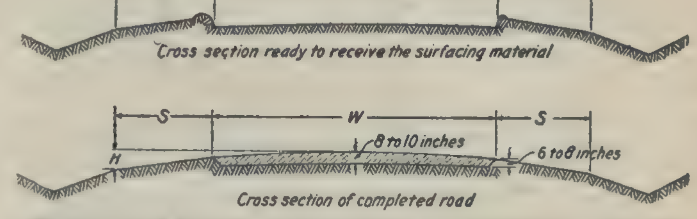
(h) Brick roads are adapted to the same general class of traffic as concrete roads. Either brick or concrete roads, however, may be economical for only moderate traffic where other road-building materials are scarce.

3. The final step in selecting the surface type is to pick out, from the two or three types adapted to the kind of traffic involved, the particular type which, in the long run, will prove cheapest. This problem usually must be solved separately for each road, because the factors which enter into its solution are nearly always different for different roads.


S
W
S
Flat or slightly crowned
Cross section ready to receive the surfacing material
S
W
S
Depth sufficient to secure finished depth shown below
Cross section showing material spread on the road ready for mixing
S
W
S
D
8 to 10 inches
6 to 8 inches
H
Cross section of completed road

A. Typical Cross Sections Showing Method of Constructing a Sand-Clay Road by Mixing Sand or Clay with the Roadbed Material.

W should be at least 12 feet for single-track road and *S* generally not less than 5 feet. For double track *W* should be not less than 14 feet and *S* not less than 3 feet; *H*, crown, varies from 1 inch to the foot for level grade to 1 inch to the foot for a grade 5 per cent or over; *D* varies from 2 feet to 6 feet, depending on rainfall and grade.


S
W
S
Cross section ready to receive the surfacing material
S
W
S
8 to 10 inches
6 to 8 inches
H
Cross section of completed road

B. Typical Cross Sections Showing Method of Constructing a Sand-Clay Road, Using Topsoil or Other Natural Mixture.

W should be at least 10 feet for single-track road and *S* generally not less than 5 feet. For double track *W* should be not less than 14 feet and *S* not less than 3 feet; *H*, crown, varies from one-half inch to the foot for level grade to 1 inch to the foot for a grade of 5 per cent or over.

Fig. 2.

The principal factors to be considered in estimating the ultimate cost of a road are cost of construction and cost of continuous maintenance. The incidental cost to the users of a road on account of deflecting traffic for periodic repairs also may be a factor in determining the relative efficiency of a particular type of road surface, but since it is practically impossible to estimate this cost, it can be considered only in a very general way.

The cost of construction depends principally on the availability of materials and the cost and efficiency of labor. The cost of continuous maintenance depends on the same considerations, with the additional elements of traffic, climate, and soil conditions to be considered. The human element which determines the kind of organization under which work is done may also have an important bearing on the cost of both construction and maintenance.

The table herewith illustrates how the efficiency of different types of surfaces may be compared after the construction, reconstruction, and maintenance costs have been estimated for a period covering the life of the most durable type considered. In the hypothetical case for which this table was prepared it was assumed that any one of three surface types (I., II., and III.) would satisfy the traffic, and the whole problem was to choose the most economical of the three types.

Method of Making Economic Comparison of Road Surfaces

Item.	Type of surface. I.	II.	III.
Estimated life of surface with proper maintenance (years)	8	10	15
Original construction cost per mile	$6,000	$10,000	$16,000
Cost of necessary reconstruction during a period of 15 years	3,000	5,000	.....
Estimated cost of maintaining surface per mile:			
Average annual	400	200	50
Total at end of 15 years	6,000	3,000	750
Five per cent. interest on all estimated expenditures for construction, reconstruction, and maintenance to end of 15-year period, per mile:			
Original construction	4,500	7,500	12,000
Reconstruction	1,050	1,250	.....
Maintenance	2,400	1,200	300
Total	7,950	9,950	12,300
Total cost per mile at end of 15-year period	22,950	27,950	29,050
Value of road surface per mile at end of 15-year period	3,400	7,500	.....
Net outlay per mile of road	19,500	20,450	29,050

For the hypothetical case illustrated the choice of surface evidently lies between Types I. and II. The net outlay at the end of the fifteen-year period is slightly in favor of Type I., but the difference is so slight that the question of which estimate contains the fewer uncertainties probably should prove the deciding factor. In this case, Type III., notwithstanding its relatively long life and low maintenance cost, could not be economically considered.

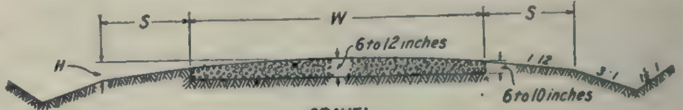
On account of the uncertainties that always enter into estimates of construction and maintenance costs it might be argued that any attempt at scientific comparisons of this kind is worthless. But the same uncertainties still would be present if the decision were made a matter of "lump-sum" judgment, and there always is a greater chance for accuracy, even in a rough guess, where each of the factors which should influence the judgment is guessed at separately. If it were desired to compare the areas of two fields, for example, the first step would be to measure or estimate the linear dimensions of each. If the difference in area were small, and the dimensions were guessed at, there is a possibility, of course, that the smaller field might be mistaken for the larger, but the probability of such erroneous judgment would be much less than if the areas were guessed at without reference to the dimensions.

Widths

The widths of the roads for which design data are shown in the table of design and cost data vary over a wide range, and appear to be practically independent of the traffic importance of the roads. This lack of relation between width and traffic importance is general, and results in large part from the necessity for designing improvements to fit cases where both the cost and length of road to be improved are definitely limited at the start.

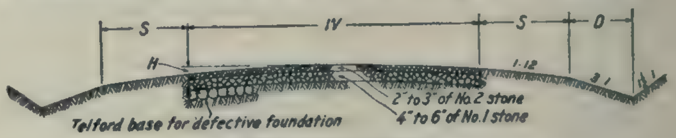
Highway engineers are fairly well agreed that for ultimate economy the surfaced portion of a road should be at least sufficiently wide to allow traffic to distribute itself over the entire surface and thus prevent the concentration of wear in two narrow tracks. The minimum width that will enable a fair distribution of traffic over the surface is about 12 feet, but a width of 12 feet falls just short of providing space for two vehicles to pass each other safely, and seldom is employed. A surface width of 14 feet is sufficient for horse-drawn vehicles to pass each other conveniently, and 16 feet is sufficient for automobiles, though 18 feet is greatly preferable, especially where the traffic is mixed. The 18-foot surface is being used to a considerable extent in many of the wealthier communities, and for moderately heavy traffic is proving economical as well as convenient.

Fig. 4 is a cross-section of the road between Washington, D.C., and Baltimore, Md., and illustrates a design which, in some cases, has proved very economical. Here a very durable surface has been constructed along the central portion of the road to a width of 14 feet, and a less durable surface of gravel or crushed stone has been constructed along each side, as shoulders, adjoining the central surface. The central width of 14 feet carries most of the traffic over this road, but the shoulders are maintained in good condition, and the whole surface, taken together, forms a much more commodious roadway than would a 16 or 18 foot central surface with unsurfaced shoulders. On less heavily travelled roads a similar design sometimes is employed, using a 9 or 10 foot width of central surface with shoulders of firm earth, gravel, or stone. For a design of this kind to prove satisfactory, however, continuous and efficient maintenance of the shoulders is absolutely essential. If the shoulders are not main-



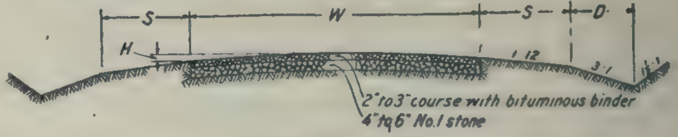
GRAVEL

"W" should be at least 10 feet for single track road, and "S" generally not less than 5 feet. For double track "W" should be not less than 14 feet, and "S" not less than 3 feet with slope 1 12 "H" crown, varies from ½" to the foot for level grade, to 1" to the foot for a grade of 5% or over



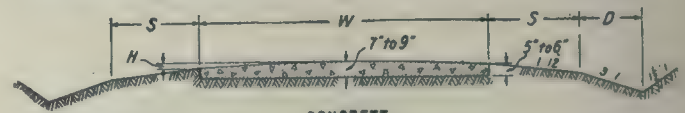
WATER-BOUND MACADAM

"W" should be at least 10 feet, and "S" at least 3 feet "D" should be from 2 feet to 6 feet depending on rainfall and grade. "H" crown should be ½" to the foot No. 1 stone = 2" to 3" in size. No. 2 stone - 1" to 2" in size



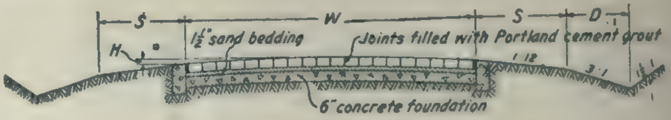
BITUMINOUS MACADAM

"W" should be at least 10 feet, and "S" at least 3 feet "D" should be from 2 feet to 6 feet depending on rainfall and grade "H" crown should be about ⅜" to the foot.



CONCRETE

"W" should be at least 10 feet, and "S" at least 3 feet. "D" should be from 2 feet to 6 feet depending on rainfall and grade "H" crown should be about ¼" to the foot

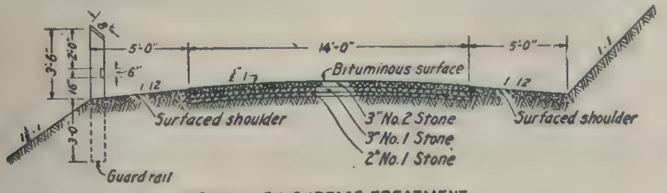


BRICK

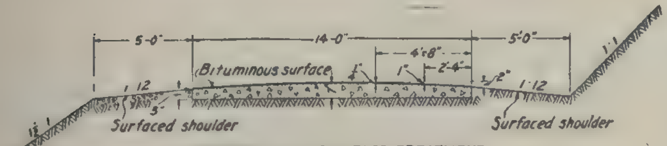
FIG. 3.—Typical cross sections.

tained true to cross-section, and firm, the danger of accidents to automobile traffic is very great. In fact, the danger may be greater than with a single-track road surface, 9 or 10 feet wide, having shoulders of sand or other unstable material, because in the latter case the drivers soon learn to take necessary precautions when leaving the surfaced portion of the road in order to pass another vehicle. They also learn to exercise care in selecting the point at which a passing is made.

No matter what the surfaced width of a road may be, the total width of roadway always should be sufficient to provide a reasonable margin of safety when vehicles are passing each other, with some allowance for unexpected maneuvers on the part of frightened animals or inexperienced drivers. A total width of about 20 feet is the minimum that will provide reasonable security and is the minimum that should be employed under any circumstances. Another consideration that frequently serves to fix the total width is that moderately wide shoulders can be maintained much more readily than narrow ones. On embankments it is customary to make the shoulders at least 4 feet wide and in cuts at least 3 feet. This means that where the surfaced width of a road is to be 16 feet its total width should be not less than 24 feet on embankments and 22 feet in cuts.



MACADAM WITH SURFACE TREATMENT



CONCRETE WITH SURFACE TREATMENT

Fig. 4.

The width of right of way necessary for a road varies with the topography as well as with the width of roadway. Where the topography is flat, or gently rolling, a 50-foot right of way is sufficient for a 20-foot road, while for very rolling or hilly country a 60-foot right of way may be required for a 20-foot road. For roadways wider than 20 feet the width of right of way should, in general, be increased by an amount equal to the additional width of roadway. In other words, the right of way should generally be from 30 to 40 feet wider than the roadway.

Grades

The question of maximum allowable grades is a very important consideration in designing a road. In deciding this question there are several important factors to consider:

1. The main roads should, in general, have easier grades than the feeder roads, so that any load may be hauled on to a main road can be hauled over it without increasing the motive power.

2. The better a road surface the easier should be the grades, otherwise the full benefit of the improved surface will not be secured on comparatively level stretches of the road. For example, on a level grade a horse can pull about twice as much over a gravel-road surface as over a surface of ordinary earth, but on a 5 per cent. grade the increased motive power required for the same loads would be only about 100 per cent. for earth as against more than 150 per cent. for gravel. In the case of motor vehicles this increase in motive power can be effected within limits by shifting the gears, and where motor vehicles will constitute most of the traffic the matter of grades is not so important.

3. According to the best current practice, the maximum grade for roads that are of sufficient importance to warrant a highly improved surface is determined in great measure by the topography of the region traversed. The following tabulation shows the usual range for various conditions of topography:

	Per cent.
Coastal plain and prairie regions	2 to 3
Average rolling country	4 to 6
Hilly or mountainous regions	6 to 8

The question of minimum grade is of importance only as regards the side ditches. These always should have sufficient fall to drain off the water they collect without allowing the roadbed to become saturated. Ordinarily it is desirable to give the side ditches a fall of not less than about 1 foot per 100 feet of length, but for comparatively short distances, and for deep ditches, a somewhat less fall may prove adequate.

On concluding this discussion of road design it is desired to emphasize the all-important fact that well-balanced and experienced judgment is a much more valuable asset in planning public road improvements than any amount of theoretical knowledge. No knowledge gained from books alone can give a complete grasp of the relations existing between a public road and the community it serves. Theory is simply the sign-post that points the way, while judgment is the vehicle on which the journey is dependent.

Pollution of Boundary Waters

The International Joint Commission have issued an exhaustive report on the pollution of boundary waters and upon remedial measures. The report describes investigations that have been undertaken to secure data having reference to the cause, the extent and the prevention of pollution of boundary waters to the injury of health or property. An appendix, No. 1, contains a report by H. C. McRae, district engineer, and I. P. Kane, assistant engineer, on the conditions in the Detroit and St. Clair Rivers, and appendix No. 2 contains a similar report, with suggested remedial measures, on the Niagara River, by F. C. Tolles, district engineer. A number of valuable tables have been compiled and are reproduced in the report, also a number of plates and drawings. The report comprises 160 pages, standard trade journal size and contains a quantity of valuable information of special interest to sanitary engineers.

Conservation of Bituminous Materials

In order to conserve the supply of bituminous material for war purposes action has been taken by the U, S, Department of Agriculture in the form of a letter sent out to the road and street officials. This letter states that a special permit of the Fuel Administration, Oil Division, will be required before delivery of purchases will be authorized. Preference is given to the sale of material for maintenance work, while material for new sonstruction, except where work is necessary as an aid in winning the war, will be held over.

Fort Qu'Appelle Sanitorium Administration Buildings - Cottages at left side.

Tubercular Sanitorium at Ft. Qu'Appelle, Sask.

By Mr. E. A. Markham, Assoc. Mem. C. S. C. E.*

IN 1911 the Anti-tuberculosis League of Saskatchewan was formed, and, after appointing their engineers, gave instructions that a suitable site should be found and purchased. Several locations were visited by the engineers, and the site at Fort Qu'Appelle was secured. Previous to making this purchase investigations were conducted, and it was found that the points governing the selection of the site would have to conform to the following requirements, namely: Accessibility, shelter in winter except from the south, direct sunlight, good water supply, and a picturesque location to add the necessary mental stimulus to the patients' recovery.

Ideal Site Obtained

The site chosen at Fort Qu'Appelle beyond doubt conforms to these requirements. In fact, the writer doubts very much if another location more suitable could be found in the country.

The estate purchased is 2½ miles from the town of Fort Qu'Appelle, on the north shore of Echo Lake, and consists of 230 acres. It was apparent to the engineers that this sanatorium would develop into one of the largest institutions of the province, and they were at once confronted with the problem that interests all engineers from time to time, namely, high capital expenditure or increased operation costs. All engineers will agree with the writer when he states that it is to the credit of the league that the engineers were permitted to suggest the full possibility of the undertaking, and from that point of view lay out the utility buildings and other works that would otherwise, at a later date, become a burden to the finances of the institution.

General Outline of the Project

Before describing the various units that are already constructed, the writer would like, as briefly as possible, to outline the full scheme as planned by the engineers.

A central or administration unit, around which the other buildings could be ranged, was the essential feature, and an infirmary and the buildings for incipient cases were next considered. The project also included the erection of a series of small cottages of four or five rooms each, for patients who could afford to undergo a treatment for this complaint in a more luxurious manner; a residence for the doctor in charge; a children's pavilion; accommodation for the outside staff; farm buildings; and, in all, every detail making for as complete a layout as possible was investigated to the fullest extent. It will be readily appreciated that as it was only possible, for financial reasons, to construct for the time being the very essential buildings, and that such units as the power-house and other utility buildings had to be designed as far as possible with a view to enlargement, both in plant and accommodation.

In regard to the financial end of the undertaking, one of the essential points insisted on by the promoters of the institution was to make it a people's sanatorium, and it was thought that enough money might be collected in a voluntary way throughout the province to finance the undertaking. The writer has no hesitation in saying that had it not been for the war this principle would have been upheld, but, owing to the tightening up of the money market, the provincial government have had to assist in a financial way. The operation of the institution is still under the direction of the Anti-tubercular League.

General Plans and Description of Buildings

The general plan or location of the various units comprising the sanatorium as at present constructed is as follows:

The administration building has its principal elevation facing almost due south. The two cottages or pavilions for incipient cases also face south, and are arranged on the west side of the building. To the northeast and 1,500 feet from this building the superintendent's residence is situated. Further north the reservoir taking care of the water supply is located, while the power-house has been kept well to the rear of the hospital units and is 800 feet north of the administration building, on the west side. The sewage disposal plant is constructed on the shore of the lake, southwest of the main building. An ice house, with a capacity of 400 tons, stands adjacent to the kitchen wing of the administration building. Other smaller buildings of less importance complete the sanatorium for the time being.

As has been mentioned before, considerable future extension has been anticipated, and it is expected that an infirmary and two more pavilions will be erected in the near future. In fact, excavations for these buildings have already been completed.

All the utility buildings, as at present constructed, have capacity for these additional units, and are planned for further extension. The main, or administration building, has a total floor area of 23,700 feet. The basement storey is used principally for storage purposes, with the exception of the staff dining-rooms, which are on this floor; the total storage space available is about 30,000 cubic feet.

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* Paper read before the Saskatchewan Branch of the Canadian Society of Civil Engineers.

On the ground floor, with a total floor area of 7,600 feet, the following accommodation is provided: East of the main hall and reception halls are the general offices, the administrative offices, matron's rooms, and the examination rooms; the drug room and laboratory complete this wing. The other half contains the dining-room, serving rooms, kitchen, diet kitchen, bakery, refrigerator plant ,and the kitchen storerooms. The dining-room has seating room for 150 patients, and has a floor area of 1,300 feet. The kitchen wing has a floor area of 2,000 feet. The first floor, with 5,000 feet floor area, has seven wards, accommodating from 25 to 30 bed patients, pending the building of the infirmary. Fresh-air balconies are arranged adjacent to all wards. The wards have a floor area of 3,000 feet and the balconies 1,200 feet. Leading from the main corridor are the bath and toilet rooms, etc. The second floor provides accommodation for the inside staff. This floor has an area of some 3,000 feet, with balcony space of 600 feet. Above this floor, and in the tower, an observation landing has been provided.

The Open-Air Pavilions or Cottages

The design of these cottages suggests the idea of a series of small pavilions, with accommodation for two patients, with dressing-room, sleeping balcony, and bathroom self-contained. These cottages, however, have bed space for 26 patients each, and have a total floor space of 9,000 feet. By way of explanation, these cottages are for incipient cases only, and the patient uses the dressing-room for the purpose of changing from day to night attire, and is wheeled in his cot by the attendant from his room to the verandahs where he spends the night. This idea has been carried out in the design of the building and the floor area of the balconies equals the floor area of the dressing-rooms, namely 1,200 feet. Two large sitting-rooms are centrally located for recreational purposes, and a bath and toilet-room is provided for every four patients. The superintendent's residence is designed along usual lines, and consists of a two-storey building of twelve rooms.

Power House

The power-house is a one-storey building, with a total floor space of 5,000 feet, which space is allocated as follows: Boiler-room, 1,100 feet; coal store, 600, with a cubature of 7,200 feet; pump-room, 1,100 feet; engine room, 900 feet; laundry, 1,200 feet.

Tunnels

Starting from the power-house and connecting all the buildings, except the superintendent's residence, are a system of reinforced concrete tunnels conveying the water and steam mains, electric conduits, etc. The tunnels have a cross-sectional area of 23 sq. ft. and a total length of 900 feet. This area of tunnel allows ample space for all service piping, and a passage-way permits of intercommunication between buildings.

Power Plant

All buildings are heated from a central plant, located in the power-house. Steam is derived from two tubuar boilers of 100 horse-power each. High pressure steam is conveyed through a 4 in. steam main to a high pressure reducing valve, and from thence to an 8 in. steam main running through the tunnels to the various buildings. Expansion joints are provided every 200 ft. in both mains and returns. The system of heating installed is the Dunham vacuum vapor system. The main return pipe is 2½ in. in diameter, connecting to a vacuum pump in the pump-room, discharging to a feed water heater and fed back to the boilers by the agency of two duplex feed water pumps. A 3 in. main and return, direct connected to the 4 in. high pressure steam main, supply a 70-pound steam pressure to the laundry for sterilizing and a 20-pound pressure to the kitchen in the main building for the same purpose. It is intended to install two steam generators connected to the headers of the boilers. The products of combustion from the boilers are carried through steel breeching to the hollow brick chimney stack, 100 feet high.

Power and Lighting

The necessary electric energy for the power and lighting is supplied by a Fairbanks-Morse semi-Deisel oil engine, belted to a shunt-wound generator of 15 kw. Storage batteries of 400 amp.-hours are provided in the pump-room. It has been found that by running the oil engine for some four to six hours daily enough energy is produced for the day, the storage batteries taking care of the light.

Water Supply

Water is obtained from an 8 in. well, sunk to a depth of 100 feet, in the pump-room of the power-house. A 4 in. suction pump, with a 24 in. stroke, operated at 30 strokes per minute, lifts the water 96 feet and supplies the reservoir, 192 feet above the discharge of the pump. The reservoir has a capacity of 50,000 gallons. The water returns to the power-house and passes through a pressure-reducing valve, reducing the gravity pressure to 60 pounds, and from thence is taken through the tunnels to the various buildings. All underground water-mains are 4 in. cast-iron; the mains in the tunnels are 3 in. galvanized iron; fire hydrants are located at each building.

Doctor's residence, Ft. Qu'Appelle Sanitorium.

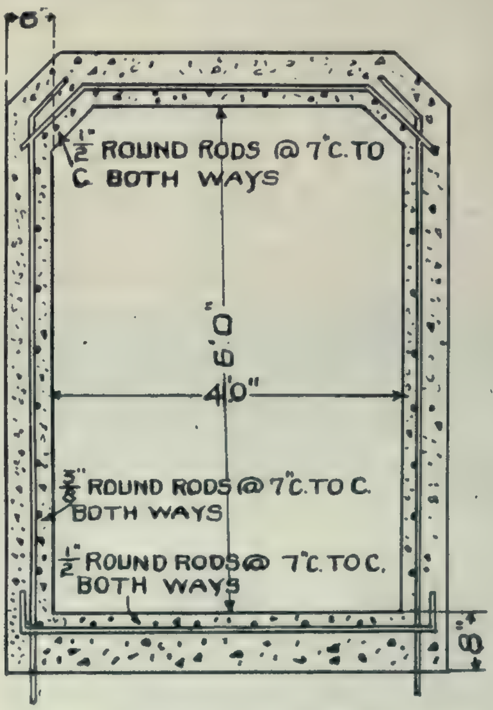
Sewage Disposal Plant

The sewage disposal plant is on the lake shore, and an explanation of the treatment of the sewage is as follows: The crude sewage flows into a well, or receiving chamber, and from thence to the settling tank. Troughing connects this settling tank and allows the sewage to pass through an automatic sprinkler to the filter beds. The sewage, having passed through the filter beds, flows into the humus tank by means of a concrete channel at floor level, and from thence it passes over a measuring weir into the chlorine tank and out through the effluent pipe. The settling tanks are provided with 6 in. cast-iron pipes and valves for the removal of the sludge.

Constructional Details

The administrative building is of fireproof construction, with reinforced concrete footings, columns, beams and slabs. The slabs are designed for the following loads: Kitchen wing, 100 pounds per square foot live load, plus weight of superstructure; other floors, 60 pounds live load per square foot, plus weight of superstructure. Kahn deformed steel bars were used throughout, and steel was required to the following specification: Elastic limit of steel per square inch, 55,000 pounds; ultimate tensile strength per square inch, 95,000 pounds; working stresses to be calculated to one-third elastic limit.

The specification for the concrete required a 1:2:4 mix. A very clean gravel, however, was obtained on the south side of the lake, and a 1:4 mix was permitted. The concrete was mixed in a batch mixer and spouted to position. Brick-bearing walls carry the outer ends of beams and slabs; all slabs were anchored to the outer wall by means of the reinforcing turning up into same.


6"
½" ROUND RODS @ 7" C. TO C. BOTH WAYS
6'0"
4'0"
⅜" ROUND RODS @ 7" C. TO C. BOTH WAYS
½" ROUND RODS @ 7" C. TO C. BOTH WAYS
8"

Cross section of tunnel, Ft. Qu'Appelle Sanitorium.

The foundation soil was very compact, and contained a considerable quantity of gravel. Tests were made and column and wall footings were calculated for a safe bearing load of 3,000 pounds per square foot. The basement walls were constructed of field stone 2 feet thick, and through stones were built in every six super feet. The mortar used was a 1:3 cement mortar, pointed on the outside with black mortar. A total of 1,500 cubic yards of this masonry was called for. Red Menomimie brick are used for the outside wall facing, and a total of 300 M. of these brick were required. White Estevan common brick were used for the backing, lined with 2 in. hollow terra cotta tile on the inside. Five hundred M. common brick were used in the various buildings. Bedford stone window-sills and trim to the tower offer suitable relief to the brickwork. Outside steps are carried out in Kettle River sandstone. The basement floors are in concrete, 1:4 mix, with 2 in. cement and sand finish. This finish cut through to the concrete every 36 superficial feet for expansion and contraction.

The major portion of all other floors is of clear maple, attached to bevelled wood screeds, with cinder concrete fill. Marble terrazza floors were cast for all lavatories; this material was also used to good effect for the treads of the main stairs, being in this case cast in moulds and set in place after.

All partitions, except on the third floor, are built of 4 in. and 6 in. hollow terra cotta tile, laid in cement mortar; 24-gauge expended metal, coated with copper alloy, covers the wood partitions and the underside of roof on the third storey.

The plastering, carried out in three-coat work, has two coats of Manitoba gypsum hardwall and putty coat of hydrated lime. Keen's cement is used for the wall of all toilets and lavatories.

The roof of this building is constructed of lumber, with 12 in. x 20 in. purlins, 2 in. x 6 in. rafters, with heavy half-timbered work to gables. The roof covering is carried out in green Westmoreland Countess slates, on rubberoid. The kitchen wing is roofed with a tar and gravel roof.

The trim for the main rooms is quarter-cut white oak and white pine trim for all other rooms; all doors are of solid or slab construction, and are 4 feet wide.

The total cost of this building, not including plumbing and heating, is about $70,000.

Cottages

The two cottages are of frame construction above the ground floor, with reinforced concrete footings and stone foundation walls. The frame superstructure is covered with rubberoid, then expanded metal, and plastered in cement stucco. The interior of each cottage is plastered with white putty finish and Keen's cement, with hardwood floors, pine trim, white enamelled. The cottages cost $16,000. The doctor's residence is similar in construction to the pavilions.

Power-House

The construction of the power-house is fireproof throughout, with reinforced concrete footings, columns and slabs, brick-bearing walls and steel I-beams carrying the roof slab. The roof is covered with a tar and gravel roof. Kahn steel sash are used throughout this building. The floor slabs are calculated for 500 pounds per square foot live load, and the roof slab 60 pounds per square foot. Total cost of building, without equipment, $13,000.

Tunnels

The construction of the tunnels follows along usual lines for this class of work. An 8 in. concrete base, with ½ in. reinforcing, spaced 7 in. c. to c. both ways; 6 in. side walls, with 3/8 in. reinforcing at 7 in. c. to c. both ways; 7 in. top slab, with ½ in. reinforcing, the same as the base. All tunnels were waterproofed on the outside with two coats of pitch. Tunnels were excavated from the ground level to underside of base slab. The reinforcing for the base and side walls was then set in position and the base slab run. The movable forms were next set in place and then the crown reinforcing. The concrete for side walls and top slab were run in one. Alternate sections of 50 feet in length were constructed at a time; the forms were then struck, reset into position, expansion joints fixed, and the intermediate sections completed. Manholes were located every 150 feet. The depth of the tunnels varies from 20 feet at the power-house to 4 feet at cottage No. 1. Cost of tunnels, $11 per lineal foot.

The reservoir is constructed of reinforced concrete throughout, waterproofed on the inside with a coat of mastic asphalt. The cost of the reservoir was $5,500.

The disposal plant is also carried out in reinforced concrete, with wood roof. Crushed rock is used in filter beds. Cost of sewage disposal plant, $6,000. Nine-inch and six-inch vitrified sewer tile connect to the disposal plant from the various buildings.

The operations on this work extended over a period of four years and three months. Operations were commenced in June, 1913, and continued without interruption until August, 1914, or until the outbreak of the war. The tunnel work was undertaken in 1915, but an earnest resumption of operations was not made until the spring of 1917; work was completed October, 1917.

Personal

Mr. J. H. Puntin, R.I.B.A., was the engineer in charge of the whole scheme until the outbreak of the war, when, upon his leaving for active service, his duties were undertaken by Mr. Van Egmond, of the firm of Storey & Van Egmond. The Parsons Construction Company, of Regina, were the general contractors for the work. The engineer for the contractors was Mr. W. R. W. Parsons, M.C.S.C.E.; Mr. E. A. Markham was field engineer. Mr. O. W. Smith, M.C.S.C.E., contracted for the reservoir, disposal plant sewers, and water-mains. The plumbing and heating contract was undertaken by Cotter Brothers, of Winnipeg; the electric work by the Northwestern Electric Company.

The total cost of the whole works aggregates $220,000.

Spring Meeting A. S. M. E. June 4-7

The American Society of Mechanical Engineers are holding their spring meeting at Worcester, Mass., this year, from Tuesday, June 4 to Friday, June 7, inclusive. Many interesting topics are being discussed and there are also social events and outings which should form an added attraction. The headquarters of the convention are at the Hotel Bancroft but many of the sessions are being held at the Worcester Polytechnic Institute. Apart from the time devoted to the discussion of subjects bearing directly on the work and problems of the mechanical engineer, there is a session on safety education in technical schools and universities, a general war session, a fuel session and a vocational training session. In view of the fact that a New England city has been chosen as the place of meeting, papers are being presented upon subjects relating to New England's industries under war conditions.

A flashlight invented in France carries an electric generator in place of the usual dry cell. The generator is driven by clockwork and it is claimed one winding of the spring will generate current for a considerable length of time.

The city of Regina, Sask., will vote on a by-law to spend $175,000 on extensions to the electric light and power plant.

PEDLAR'S FERRO-DOVETAIL PLATES

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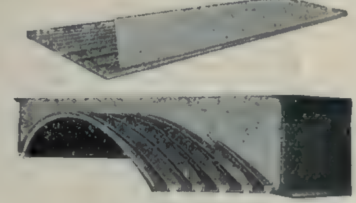

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Mainly Constructional

East and West—From Coast to Coast

The last stone of the exterior work on the Toronto Union Station has recently been placed in position.

Permits for the erection of dwellings to the value of $86,085 were taken out in Toronto in one day recently.

There is a rumor that a military hospital may be erected on Duchess Street, Toronto, where the government has obtained options on a considerable amount of property.

The revival of the toll system was proposed at a recent meeting of the New Westminster, B.C., Board of Trade as a means of providing revenue for the paving of the Pacific Highway to the boundary.

The estimate of the expenditures to be made on a system of county roads in Grey, Ont., as approved by the order-in-council for the present year is as follows: road construction, $7,000; bridge construction, $8,000; superintendence and repair, $30,000; making a total of $47,500.

While drilling for gas in the township of Dover, in the county of Kent, Ont., near Lake St. Clair, the Union Gas Company recently struck an oil gusher. The well, which had been drilled to a depth of 3,200 feet when oil was encountered, is said to be one of the best ever discovered in Ontario.

The chairman of the finance committee of Woodstock, N.B., recently visited St. John to negotiate the sale of $30,000 town bonds issued for the completion of the filtration plant. A large number of men have been secured from St. John by Contractor Mooney and the work on the plant will be pushed as rapidly as possible.

The concrete ship "Faith," which may be considered the pioneer of ocean-going concrete vessels—on this side of the water at least, has made a successful trial voyage along the Pacific Coast. "She acted just like any other vessel," said her captain, commenting on her behaviour during the trip. "We had some very rough weather and the Faith certainly stood the test," he said.

The Invalid Soldiers' Commission contemplate the expansion of the King Edward Sanatorium at Tranquille, B.C. If it is decided to go ahead with this undertaking, work will start immediately on a brick and reinforced concrete addition large enough to provide for at least 300 beds.

The council of York township, Ont., have received authority from the Minister of Finance to issue debentures to cover the expense of necessary additions to the township waterworks system.

The erection of new buildings providing hospital accommodation for from 1,200 to 1,500 soldiers is to be the initial work by the Dominion Government at the St. Andrews College property, Toronto. Ten bungalow type structures will be erected, each capable of housing 150 men. There will be four wards in each building, which will be semi-permanent, but without cellars. The first buildings put up will be planned as to permit the addition of a further number of wards at a later date.

The Essex Border Utilities Commission has instructed Engineer Morris Knowles to proceed at once with the preparation of plans and estimates for a waterworks system to serve Ojibway, Sandwich, and the township of Sandwich West. The Commission has also ordered a separate report to be prepared relative to the cost of a system adequate to supply water to all the border cities, including Windsor. The cost of the scheme, embracing all five municipalities, is placed at approximately $2,000,000. The lesser scheme will cost, it is estimated, one-half this amount.

Four alternative proposals were submitted to the Toronto Works Committee by Commissioner Harris for the construction of a temporary trestle crossing at Glen Road in connection with the Bloor Street Viaduct. The plan adopted by the committee provides for the erection of a trestle for street railway and pedestrian traffic at an approximate cost of $4,650, vehicular traffic to be diverted to Howard Street over a route of 530 feet longer than that offered by the viaduct. The plan which the Commissioner advised was for a trestle with a width of 63 feet, with provision for street railway traffic, a 34-foot roadway and 8-foot sidewalk. The head room allowance under this arrangement would be 12 feet, the roadway level being 3 ft. 9 in. above established viaduct grade, with ramp approaches on the east and west. The approximate cost of the construction of the trestle would be $7,000, if this scheme were carried out, but there would be a further $22,000 involved for roadway, drainage and guardrail, which would be destroyed when the permanent work is accomplished. The total cost would therefore be $24,450 more than that of the plan adopted.

The work to be done on the Fraser River this year includes the straightening of the channel at a point immediately below Woodward's Landing. At the present time the official channel at this point follows a course south of Mark Island, but the bulk of the water flows north of this island and it only requires a little dredging to make the latter channel better than that now being used. The government has also been requested to construct a wing dam to protect a part of the Sandheads north jetty, where the current is threatening to cut through into Hayseed Channel. Another matter brought up is the widening of the cut between Nos. 1 and 3 buoys, where owing to the channel making a turn of 45 degrees, the effect is to cause it to silt up. Mr. A. R. Dufresne, assistant chief engineer of the Department of Public Works, recently made an inspection in connection with the above work. It is not definitely stated whether the latter two items will be attended to this year.

Personals

Mr. F. A. Danks has resigned from the works department of the city of Toronto to take a position with J. B. Nicholson, Limited, Hamilton, superintending the construction of reinforced concrete grain elevators, reservoirs, etc. Mr. Danks, who is a 1908 graduate of the Faculty of Applied Science & Engineering, Toronto, had been in charge of field work at the filtration plant at Toronto Island.

Mr. R. R. Maitland, of Vancouver, and Commissioner McClay, of the Vancouver Harbor Board, recently visited Ottawa for the purpose of interesting the government in the proposed plans for improvement of the harbor of Vancouver, and of securing concessions in the form of financial and other aid. Mr. Maitland states that their mission was attended with success, assurance being received that the government intends putting through a bill next session granting the necessary aid.

Lieut. H. N. Darling, who went overseas with the C.P.R. Battalion of Railway Construction, has been awarded the Military Cross in recognition of his bravery and devotion to duty in saving a large amount of valuable railway equipment during the operations around St. Quentin in the early spring. Lieut. Darling is the first of his battalion to receive this decoration and also was the first to be promoted to officer's rank. He is a Toronto man and well known in local construction circles.

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After-the-war Problem Reconstruction vs. Restoration

IT is not simply the word restoration which is in vogue to-day when dealing with after-the-war problems. While it is no doubt true that restoration as applied to many of the historic buildings which have been demolished by the enemy, would be a most desirable outcome, were it possible to carry out this work, damage has been done to such an extent that restoration is entirely out of the question. Then again, we have buildings which cannot be restored because of lack of knowledge of the construction of these ancient structures. The problem confronting us is, then, more correctly quoted by Mr. R. M. MacIver, Associate Professor of Political Economy of Toronto University, as that of "reconstruction." In many instances it would be folly to reconstruct without departing from the old order. So many undesirable features, especially in cities which have grown rapidly, now exist and practically cannot be repaired without enormous expense, if at all, that any opportunity now afforded for improvement should not be lost sight of.

In many cities to-day there are features in planning, which cause congestion to an alarming extent, simply because provision in the original plan was not made for the future growth. Yonge Street, Toronto, is a good example of how insufficient width of street will result in future years in a most objectionable congestion, which has been and is yet one of the prevailing problems of the city. Street widening is made practically impossible by high land values, hence new methods of transportation have to be adopted. This may relieve the congestion, but even so, the same light excluding and unsanitary qualities of the narrow street crowded with high buildings, remain.

It is hoped that the great opportunity arising from the war, in making the total reconstruction of many towns necessary, will be taken advantage of for the purpose of planning for future extension as well as to eliminate the old objectionable features. In the reconstruction of Halifax we trust that careful planning will give results which will be a credit to the engineers, as opportunity is afforded, by a great disaster, to improve the city topographically.

Records and Cost Systems Invaluable to Contractors

THE contractor should keep a record of costs as well as an outline of the methods used in all his work, if he is going to do justice to himself and gain public confidence as a business man.

In order that full knowledge of the cost of any product be acquired, it is important that a detailed study be made of the costs of raw materials, labor, etc., which existed when the product was manufactured. If a profit was realized under certain existing conditions at one period, perhaps at another time, the same product would yield only half the profit. It is plain that the only method of judging costs in this matter is to keep an accurate record of all rates and expenses of the production, so that the knowledge of the manufacturer may be such as to enable him to estimate future costs with a fair degree of accuracy.

In the same way, exactly, keeping tab on costs is of great service to the contractor. He thus has a detailed record of his work, and in bidding on other work at any future time, he can name a price which is fair to all, instead of working along in a slipshod manner, content with raising his price high enough, as he guesses, to eliminate danger to himself. If he "guesses" too high he robs his employer; if too low, he loses financially—neither is just nor necessary.

Cost records should not only apply to some particular ideal condition, but the most adverse and difficult propositions should be carefully recorded and the average taken, as a precaution, resulting in a legitimate safety factor. Many points which come to light on the work, if not needed immediately are lost sight of and when the time comes to bid on a new piece of work these points are entirely overlooked until it is too late. A cost keeping system should be as simple as possible in order to save time in using it. Regarding the forms used, etc., any contractor can easily obtain a set of forms which would best suit the line of work he generally follows. This will do away with a good deal of useless ruling of forms which only tend to complicate the system.

When the cost of the work has been determined, this cost data, if made accurately, is the only basis on which bids can be made. These facts cannot be disturbed by after judgment. The first bid submitted should be the final bid. It is this alteration of bids to compete with our opponents that spells ruin in many cases. If a bid which has been prepared from a carefully kept cost record be submitted and refused as too high, the contractor is not in doubt as to whether he really did bid too high. He knows that he cannot undertake the work at a figure to compete with this lower priced opponent's bid; he does not waste time, but seeks other fields and finally builds up a reputation which enables him to compete successfully in any line of work in which he has had experience. This gives him an opportunity to extend his business since he has won the confidence of the public.

The Cost Plus System

WE believe there are now few up-to-date contractors who do not advocate the cost-plus contract system as the better method of doing business. The lump-sum tender is really a relic of old times, before the scientist, the efficiency engineer and the expert accountant introduced their modern ideas and "third-place decimal" exactitude to the industrial world. The frequent eccentricities of the lump-sum system are well illustrated in recent bidding for the erection of a school in an eastern town. There were five bids, which, in order of value, were as follows: $96,400; $112,447; $114,300; $124,853; $125,574. It will be seen that there is a difference of close on $30,000 between the lowest bid and the highest, and between the two lowest bids there is a difference of over $16,000. The lowest tenderer was, of course, awarded the contract, and it is quite apparent that either he stands to lose considerable money, or else the other contractors, had any of them been successful, would have received an altogether exorbitant profit. It is such results as these that disgust modern contractors with the old, haphazard system of carrying on business.

Dominion Power Board Formed

WITH a view to co-ordinating all activities of the Federal departments with regard to the investigation and administration of matters relating to the fuel and power resources of the Dominion, the government has constituted a Dominion Power Board under the chairmanship of the Honourable Arthur Meighen, Minister of the Interior. In these various departments there are officials who have for years given the fuel-power problems of the country intensive study and have accumulated in their respective offices a great deal of valuable information respecting the available supply for present use and as to the possibility for future use of the fuel-power resources of the Dominion. It has been recognized that such information should be collated and systematized that it may be used as the basis of study for determining the most advantageous use of our water powers for domestic, commercial and industrial purposes, having in mind the co-ordinating of the use of both our water and fuel resources. So far as the present or immediate future is concerned, the fuel-power requirements of the country are being handled with marked ability by the Fuel and Power Controllers, but consideration of the future demands that there should be a co-ordination in the development and use of our varied power and heat producing resources which will combine the effective use of all along lines for which each is best adapted, and, by avoiding duplication and misdirection of effort, promote the efficiency of both individual and conjoint use.

Cheap power promises to be one of Canada's greatest assets in the post-bellum industrial rivalry of nations for world trade. Our great fuel reserves supported by our water power resources should be a sure source of cheap power, and should guarantee Canada her share in world trade, if they are availed of to their maximum possible advantage.

In addition to the Chairman, the Dominion Power Board will consist of the following nine officials, of which Mr. St. Laurent will be vice-chairman and Mr. Challies secretary:—Arthur St. Laurent, Assistant Deputy Minister, Department of Public Works; C. N. Monserrat, Consulting Engineer of the Department of Railways and Canals; W. J. Stewart, Consulting Engineer to the Department of External Affairs regarding International Waters; John Murphy, electrical engineer to the Dominion Railway Commission; H. G. Acres, chief hydraulic engineer, Hydro-electric Power Cimmission of Ontario; O. Higman, chief electrical engineer, Dept. of Inland Revenue; D. B. Dowling, geologist, Department of Mines; B. F. Haanel, chief engineer, Fuel Testing Division, Department of Mines; J. B. Challies, chief engineer and superintendent, Dominion Water Power Branch, Department of the Interior.

Shipbuilding Plant for Halifax

According to the recent announcement of the Department of Marine and Fisheries, a big shipbuilding and repair plant is to be established at Halifax, N.S. This project is being promoted by a company known as Halifax Shipbuilders, Ltd., in which Mr. James Carruthers and Mr. J. W. Norcross, of the Canada Steamship Lines, Ltd., and Mr. R. M. Wolvin, president of the Montreal Transportation Company, are interested. No assistance is being given by the government to this firm except by the placing of a limited number of contracts at fixed prices for the construction of modern steel freighters. These vessels will be of the highest class and of about 10,000 tons capacity. It is also announced that the present dry dock at Halifax, which suffered some slight damage during the catastrophe of last winter, has been acquired by the government and will without delay be put in first class condition, and in that connection there will be installed the necessary machinery to enable ships of the largest class visiting the port to make repairs, etc. The property immediately adjoining this dry-dock, known as the Acadia Sugar Refinery property, has been selected as the site for the new plant of the Halifax Shipbuilders, Ltd. Construction operations on the latter undertaking are to be commenced at once and an expenditure of $3,000,000 is contemplated on plant and machinery.

Brigadier General Frederick O. W. Loomis, of D. G. Loomis & Sons, general contractors, Montreal, has been made a Companion of the Bath on the occasion of the King's birthday honors.

Mr. Raymond Chartrand, who was formerly prominent as a contractor, died on June 4th in Montreal, aged 82. Mr. Chartrand was the contractor for the Hotel Dieu, St. Peter's Church, Technical School, Court House and Post Office.

"Old Mill" Bridge over Humber River, on Home Smith property, York County,—Frank Barber, Engineer.

Handsome Bridge over Humber River

Built in Strict Keeping with Surroundings, of Humber Valley Stone—Roadway 25 ft. in Width

Some interesting features in relation to bridge design and construction are shown by the new reinforced concrete arch bridge over the Humber River at Catharine street, Toronto, near the Old Mill on the Home Smith property. This bridge is one of the most handsome structures of its kind in the province.

The type of bridge is a reinforced concrete arch, faced with masonry, and consisting of three spans, as shown in the photographs. The centre span is 82 feet, and the two side spans 60 feet. The distance between abutments is 228 feet, while the total length of the structure is 282 feet. The height of the bridge is 27 feet and its floor width 25 feet. It is designed for heavy loading. The total cost of the structure was $42,000.

The work of construction was started late in the spring of 1916. Work was rushed, resulting in the bridge being open for traffic before Christmas. The foundations were carried well down into the shale, which was of a fairly solid formation, the west abutment foundation being carried down some 20 feet.

View of Bridge from up-stream side.

The stone for the structure was taken directly from the Humber River right near the site of the bridge. This is in keeping with the general plan of the promoters of this property, whose idea it is to have the various structures so built as to appear a natural part of the surroundings. Having this in view, many residences in the vicinity are built of this same Humber River stone and we understand that, as an inducement in this direction, all builders of residences are given the stone free of charge. The new bridge also was so designed as to fit well into the landscape without an effort at exterior adornment. That the result has been successful is beyond doubt.

A feature in connection with this bridge is the insetting of three coats of arms of the townships of York and Etobicoke and the county of York. An additional feature is the stone carved name plate on the north column at the east end of the bridge. This plate is so placed as to be readily visible to all passers-by and bears the inscription:

1916
OLD MILL BRIDGE
York County Commissioners
W. J. Knowles, Warden
Geo. B. Padgett Thos. Griffiths
Arnot Construction Company, Contractors
A. H. Chapman, Consulting Architect
Frank Barber, Bridge Engineer

The plates bearing the coats of arms are about 6 feet square and very handsome in design, as shown by the reproductions herewith of two of them.

Specifications

The specifications, for the masonry in particular, were very carefully drawn up and the construction was carried out in a most workmanlike manner by the contractors. In quality it is apparently equal to the masonry work seen in the best built houses.

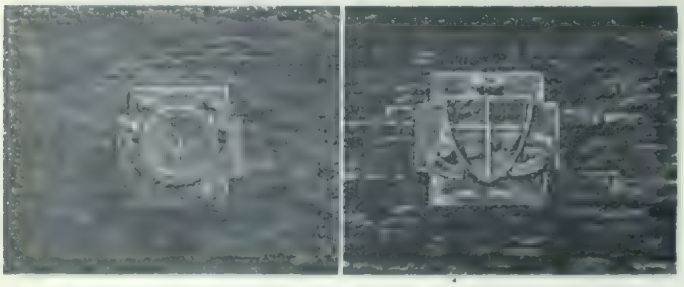
It will be noted that the roadway of 25 feet shows a considerable increase in width compared with other bridges under equal conditions of traffic. Great credit is due to the county officials in making provision for future needs.

The lights for the structure are placed compactly and artistically on the four corner columns. The fixtures, which are of a dull black finish, are hexagonal in design with semi-circular crown and are to be fitted with diffusing glass.

View of Bridge from down-stream side.

After the bridge was constructed the city spent a considerable sum in improving the approaches and erected a small masonry breakwater at the south-east corner, shown in one of the photographs.

It is interesting to note that the increased width of roadway and ornamental features were due to the generosity of Mr. Home Smith, who some time ago deeded land in the flats to the city of Toronto, to be kept for park purposes, the city agreeing to spend a specified sum per year in improvement work; the $12,000 given by Mr. Smith to improve the construction of the bridge was a part of this amount. The city intends to further improve the approaches by lessening the grades and improving the alignment of the earth approaches, while arrangements have been made to carry water mains, ets., over the bridge itself.



Two of the coats of arms set in the sides of the bridge.

The general contractors were the Arnot Construction Co. Mr. Chapman was the consulting architect, and the bridge was designed and the work of erection supervised by Mr. Frank Barber, Toronto, engineer for the county of York.

The Hydraulic Ram as Applied to City Water Supply

THE high efficiency of the hydraulic ram when applied as a pumping unit for the supplying of water to institutions, farms, etc., has long been recognized. Its low initial cost, combined with simplicity of construction and dependability, has resulted in its adoption wherever natural conditions favor its use.

It is only recently that the hydraulic ram has been used on a large scale as a city water supply unit. The following article by Mr. T. H. Carber, assistant engineer of water supply, Seattle, appearing in the News-Record, gives some interesting data on the rams used at Seattle:—

This plant should be of interest to engineers, since it is believed that it develops perhaps the highest known combined power and pumping efficiency of any existing plant of like size or larger, and in addition shows unusual economy in installation and operating costs. It consists of two 12-inch hydraulic rams operating under a 50-foot power head and against a pumping lift of 140 feet from a point above the rams to the full tank level. Performance tests showed a range of capacity of water pumped from 720,000 to 1,300,000 gallons per day with corresponding efficiencies of from 90.8 to about 85 per cent. The normal daily operating capacity is something over 1,000,000 gallons of water pumped.

The main supply line from Cedar River to Seattle discharges at its far end into the Maple Leaf reservoir at El. 420 feet. A 30-inch overflow pipe, gate controlled, leads from this reservoir to the Green Lake reservoir, half a mile distant and 100 feet lower. The Green Lake reservoir supplies the lower areas in the northern part of the city and the Maple Leaf reservoir the intermediate levels, leaving the higher levels to be supplied from a tank fed by a pumping station. Power for pumping is available from the water flowing from the upper to the lower reservoir. By using the rams with their high efficiency not all of the 100 feet available head is required. In fact, 50 feet only is used thus, allowing the plant to be located close to the Maple Leaf reservoir and the high-service tank and eliminating the long delivery line that would otherwise be required. The supply water for the rams is taken out of the 30-inch main by means of a 30 x 30 x 20 x 20-inch cross located just below the reservoir embankment. On one side the cross discharges into a short header from which individual 12-inch cast-iron supply lines 165 feet long lead to the rams, while on the other side the cross is connected with a 16-inch standpipe running up over the reservoir embankment. The function of the standpipe is to take care of the oscillation due to the ram action and allow the 30-inch main to feed steadily, thus reducing the water-hammer effect in this line.

The rams are set in a 12 x 14-ft. vault at the side of the existing gate house. Space is left in the vault for a third machine to be installed. Entrance is gained from the gate house. The rams discharge their power water downwardly and outwardly through their bases underneath the level of the tail water. This entirely eliminates splashing and with the exception of the tail-water pits the vault is dry at all times. The tail water is carried away through a 16-inch waste pipe and returned to the 30-inch line some 300 feet below the gate house. The rams discharge through short lengths of 6-inch pipe which connect outside the vault to a 16-inch main leading to the tank, 1,500 feet distant. Eventually the plant capacity will take care of some 28,000 population and furnish ample fire protection for the 790 acres involved. The rams are simple in operation. They are started with an auxiliary starting valve and adjustment for capacity is made by turning an adjusting screw up or down. All mechanical movement is limited to simple valve shifts of small motion, and as all moving parts are inside the machines, in water, no oil is used or required. The rams operate continuously in the locked gate house and inspection is made only once or twice a week by the regular water department employee. Maintenance and renewals, limited largely to new valve seats, are estimated to cost not to exceed $10 per year per ram. As wear is exceedingly light the rams maintain their full efficiency for long periods.

The accompanying table shows results of tests made by the city engineering department. Each of the two rams showed practically identical results. One ram only was tested at a time, the measuring weir being too small to allow of full plant capacity. Water pumped was measured volumetrically in the tank.

Strokes per Minute	Power Head, Ft., H	Pumping Head, Ft., h	Water Wasted, C.F.S. Q	Water Pumped, C.F.S. q	Efficiency Per Cent. $\frac{q\,(h)}{(Q+q)\,H}$
65	48.7	130.7	1.08	0.555	90.8
50	48.0	131.6	1.53	0.755	90.5
45	48.0	133.8	1.78	0.846	89.6
41	47.9	131.2	1.91	0.915	88.8
40	47.9	133.8	2.04	0.930	87.5
37	47.9	127.8	2.04	1.020	89.0
32	47.8	135.9	2.66	1.080	82.3

Road Construction at the Front

What American Road Men are Doing—Work Consists Chiefly of Maintenance—Waterbound Macadam France's War-time Road

ONE of the most interesting addresses before the recent Hamilton Good Roads Congress was an address by Col. McKendrick, describing his experience in constructing and maintaining roads in France. What the American army is doing in the way of road construction is discussed by R. K. Tomlin, special correspondent at the battlefront, in Engineering News-Record of May 16. More than ever it is evident that this is a war of science. Some extracts from Mr. Tomlin's paper follow:

Just a little more than a month ago—on February 15, to be exact—road work up near the front was begun by American forces. Since then things have moved swiftly. About 1,500 men are now engaged in road reconstruction, maintenance, and quarrying in this advance zone. They are operating in seven groups, each group being assigned to a territory with definite limits. Five quarries are being worked by our men. Mechanical equipment has begun to arrive. Several crusher installations have been set up, among them one with overhead bins and mechanical elevating equipment, said to be the first of its kind to be erected behind any front in France since the war started, almost four years ago. Four days after the machinery and wood for the bins arrived at the quarry site our men had this outfit producing crushed rock. Nor have we stopped at the innovation of the portable crusher plant with its elevating conveyors and storage bins. We are causing a good deal of comment among French engineers, I am told, by the use of bottom-dump wagons and elevating end-dump motor trucks. Such equipment as we are using for quarrying and transporting rock is a decided novelty over here, where the practice of depending on hand labor rather than mechanical plant is far more general than is the case in the United States.

Not Concerned with New Roads

As I stated in a former report, our road builders do not have to concern themselves to any great extent with the construction of new roads. There are already plenty of highways leading to the front, and our job now is maintenance, reconstruction and widening of existing waterbound macadam roads. Where our road and quarry regiments are operating near the front the amount of work to attend to is about one mile of road per square mile of land. Certain "national" highways leading toward our battery positions and trenches are already of ample width and possess good foundations and drainage. Ordinary maintenance work is all they require. Some of the offshoot roads, however, are only from 9 to 12 feet wide, and these must be increased to from 18 to 25 feet in order to carry artillery and motor truck traffic. These offshoot roads are in most cases too thin to stand the heavy traffic of war and our men are reconstructing them.

The reconstruction work involves the preparation of a subgrade which is not rolled, and the laying of a foundation course of large stone or "blockage" to a thickness of 20 cm. This blockage is set by hand and chinked in with smaller stones. Then on top of it is spread a 10-inch layer of crushed stone, 1 to 4 inches in size, this layer being extended across the surface of the existing road, which serves as a base for about half of the widened route. When a roller is available the top course is rolled down; otherwise the compacting must be done by the traffic itself.

Kind of Road Used

There is nothing very elaborate about the work. It is macadam road reconstruction reduced to its simplest form, for under the conditions that obtain in the advance section our engineers have found that this is the only type of road it is practicable to build and maintain. The captain of engineers in charge of our advance section work states the case thus: "The war-time type of road for France is the waterbound macadam road. It is the road for which local material is available and for which the methods of maintenance and reconstruction are simple. The fact that the local stone has a high cementing value is another argument in its favor." The stone referred to is a soft limestone, almost white.

Our policy in road building is to use local material as far as possible, thus cutting down on the length of haul for crushed stone. This is very important, for with quarries located far from the job the motor trucks hauling crushed rock for maintenance and reconstruction destroy the very roads for which they are bringing up repair materials. Then, too, it is now, in the early spring, that the roads are subjected to their severest test, for at this time military activity generally increases after the winter's lull and the roads must be cleared, so far as possible, of all traffic which does not carry ammunition, supplies and the other essentials of combat and sustenance. Giving weight to all of these factors, our road service is opening up, or taking over from the French, many quarries, on the theory that many quarries mean short hauls for crushed rock, and consequently fewer trucks operating on the highways.

Quarrying the Stone

Up to within a short time ago most of our quarrying was a hand-labor job. Some of it still is, but our aim is to install mechanical equipment at all quarry sites just as soon as such equipment is to be had. It is of the semi-portable type, with jaw crusher, overhead bins and elevating conveyors. This plant was set up in four days. As previously noted, this layout is a decided departure from previous practice of the allied armies behind the front. The rock here is the prevailing soft limestone which, after being blasted—generally at night—is loaded into wheelbarrows and delivered by inclined runways to the jaw crushers.

The elevated bins have two openings below. The larger of these is for motor trucks, while the other is for light railway (60 cm. gauge) cars. American quarry practice over here is making a marked cut in the man-power required for operation by the provision of gravity loading of crushed rock into motor trucks, light railway cars and bottom-dump wagons.

The captain in charge of the work had established his camp only a few days before my visit to this quarry, and, eager to increase his output of crushed stone, he was preparing to build a crusher of his own from odds and ends of metal which he had ferreted out in a junk shop in a near-by town. "As soon as I can get the authorization to spend a few hundred dollars for this stuff," he said, "I will have a crusher set up and running in a few days." This spirit is typical. Our men have had to proceed with their work in the face of difficulties of all sorts, shortage of men, shortage of plant, delays in railroad shipments, etc. Yet they are not sitting down and waiting for something to turn up. When mechanical plant does arrive it is set up in a jiffy; if it is delayed, some sort of makeshift is resorted to, or else the rock is barred out and broken by hand. From four of our quarries where mechanical plant of some type is in service we are turning out about 500 cu.m. of rock daily, and the work is as yet hardly organized.

Method of Hauling

Most of the transportation of crushed rock from quarry to road is done, at this writing, by motor truck or horse-drawn dump wagon. A number of Mack motor trucks are in service for the longer hauls and Watson bottom-dump wagons for lesser distances. Both schemes of dumping—the automatic elevating body in the case of the motor truck, and the bottom opening leaves in the case of the wagon—are decided novelties among French road builders and their first performances were in the nature of spectacles watched with the keenest interest. Much of the road stone is delivered by the French in small, two-wheel carts, hauled by a pair of horses in tandem.

Organization

The men of our road-building and quarry regiments have been divided into gangs and are quartered close to the particular jobs to which they have been assigned. At some places camps have been established and the men live in wooden barracks. Others, newly arrived, are occupying canvas tents for the present. Still others are billeted in French towns. The road service is providing everything possible in the way of good food and clothing to make life comfortable for the men. Many of the rank and file are experienced construction men, road builders or engineers with degrees from our leading technical schools, who expected to be assigned, on their arrival in France, to jobs of a supervisory capacity; for example, as bosses of gangs on road reconstruction or maintenance. Up to the present time it has not been possible for all of these expectations to be realized and men with qualifications which would ordinarily place them in positions carrying varying degrees of authority are at present swinging pick and shovel or breaking rock. When we have at our disposal a larger supply of labor battalions and have captured more prisoners it is probable that there will be a change in the status of many of our road builders who are now doing ordinary day-labor jobs. Nevertheless, the men are buckling down to their tasks and showing an excellent spirit.

Judging by what I had to eat at one of the quarry camps there is nothing to complain of on the score of "grub." To some of us here in France who have either to pass up coffee or sweeten it with saccharine, eat brown war bread without butter and smoke French cigarettes, the lot of the military road builder, even if his job is for the time being of the routine, manual labor sort, seems to have its compensations, for he gets white bread to eat, real sugar in his coffee and American "smokes," which, in themselves, should discount many of the things which may be not quite to the liking of the man who is spreading crushed stone instead of supervising the work of German prisoners.

It is still a little early to attempt to tell the real story of our road-building work. That will come later, when all of our quarries are located, equipped and running full blast, and when our work of reconstruction and maintenance has been extended and put to the test of carrying the traffic of war for a longer time than it has done up to the present. Yet I am able to report real progress in the advance section of our road service, and I cannot do it better than by quoting from a note written to the commanding officer, lines of communication, advance section, by the general commanding the first division of the American Expeditionary Forces, behind which our road builders have been at work. Here is what the note says:

"I was very hard pressed in the sector on account of terrible roads, daily growing worse under hard usage. It was necessary to act quickly and directly with G.H.Q. Your men are doing good work . They are really saving the situation."

The partnership of Madigan & Darbyson, engineers and contractors, has been dissolved, and Mr. W. H. Madigan is continuing on his own account at 30 St. John Street, Montreal, having removed to that address from the New Birks Building.

Do Structural Materials Fail From Fatigue?

Excess Loading and Weathering Action Not the Only Factors to Be Considered—Hysteretic Loss—Energy Absorbed Under Repeated Stress

THE behavior of structural materials under stress has been fairly well established by experiment. The elastic limit, ultimate strength and deformation at the point of rupture have all been carefully determined. The elastic limit of a material has been defined as the point beyond which a material, if stressed, will not return to its original length. Little has been said about the rate of deformation or the effect of continued deformations on the material. In design the main object has been to keep well within this limit.

It has been assumed that as long as a material is not over stressed and barring the weathering action, there is little to worry about as to how long a material will give service. It has been found that a material fails to follow the same rate of deformation in relation to the applied load, during the period of release of stress as during the period of its application and that the fatigue failure is probably due to absorbed energy.

That research work in this connection offers a new and unlimited scope is shown by Mr. F. J. Schlink, associate physicist, U.S. Bureau of Standards, of Washington, D.C., in the following article appearing in the Engineering News-Record :

Definition of Hysteresis

"Hysteresis may be defined by reference to the load deformation curve of a specimen carried through a cycle of loading and unloading. The result of the difference between the behavior of the specimen with the load increasing and that with the load decreasing, is that the lines of the load extension graph corresponding to these two processes are not coincident. This displacement when exhibited through a complete and closed cycle of loading and unloading, gives rise to a loop known as the hysteresis loop. The area of this loop represents the loss of energy due to imperfect elasticity, that is, a portion of the energy supplied to the specimen during the cycle which is not recoverable when the stress is returned to its original status. It seems obvious that this absorbed energy is somehow related to the so-called fatigue failure of structural materials under repeated stress application. This energy is largely expended in breaking down the structure and tenacity of the stressed body.

The Action of the Fibres

To give concreteness to this consideration, let us consider the case of a body in which the component elements may be looked upon as of finite dimensions; for example, a specimen of cloth. When a tensile load is applied to this material it is certain that before all of the longitudinal yarns can take up the stress, a phase of mutual adjustment of the yarns and their component fibres must take place. Some will be slack while others will be taut, some will be in close adherence to their neighbors while others will have comparative independence of action in the initial unstressed condition. When the load is applied the slack fibers and yarns take up a portion of the load, after the first stretching of those that are taut, while those which adhere to adjacent ones will slip relatively to their neighbors in amounts dependent upon their orientation, their moduli of elasticity and their initial tautness. As the load increases, these adjustments within the fabric decrease until incipient failure sets in.

If, before the last named state is reached, the load is removed, the specimen will return to a condition of zero stress, but its extension will not return to zero, as some of the displacements which have taken place during the earlier stages of stress application are not reversible, being maintained at more or less definite values by the friction which exists between the contiguous elements. If a second cycle of loading take place, many of these adjustments will not recur, since the fibers have been permanently disposed into positions more favorable to uniform distribution of the stress. A fairly definite proportion of them, however, will recur, comprising mainly those which, due to insufficiency of friction between elements, have been allowed to appropriate their initial condition of slackness or mutual contact. Thus at every repetition of the loading and unloading cycle certain slips and shifts will take place in the fabric, decreasing, however, in number and extent with each succeeding repetition,

It is this condition which must largely account for the ultimate failure of the fabric under repeated loadings, since the energy involved in these slips and shifts of the fibers and yarns is largely expended in mechanical wear of the material itself, diminishing the effective cross-sections and breaking down the adhesions and interlockings which exist between the component fibers of the yarn and between the component yarns of the fabric.

Possible Relation Between Hysteresis and Endurance

It is believed that something of the same sort goes on in the more usual structural materials, such as metals, masonry, leather, etc. We know that even in the metals a discernable slipping of crystal surfaces actually does occur under repetition of stress. Is it not quite likely that the form and magnitude of the hysteresis loop will afford an index of the endurance of the material under repeated load, an index in fact far superior to that obtained through the expensive and protracted endurance tests ?

Helical springs, as is well known, have superior properties as regards endurance under repeated loading compared with flat springs working under ostensibly equivalent unit stresses. May this not be due to a greater uniformity in the stress condition which obtains in the helical spring within a given bundle of contiguous elements, in contradistinction to the relative slipping and interstrain between contiguous elements in the flat spring which, as the beam theory shows, functions under stress conditions varying in every cross-section, both longitudinally and transversely ? Expressed in somewhat different form, may not the difference between favorable and unfavorable properties of a given structural form as regards endurance under repeated stresses be expressed as a function of the gradients of stresses across its sections?

In the large field of measuring instruments, the role of hysteresis is a vital one, being evidenced by differences in successive instrumental readings under identical conditions as regards the quantity being measured and the other circumstances associated with the observation. For example, in an aneroid barometer, the reading at a given atmospheric pressure will differ accordingly as the pressure has been increasing or decreasing. Two causes contribute to this: the first, backlash in the mechanism, and the second, hysteresis, principally in the force-measuring elements of the aneroid—the diaphragm and the spring.

The amount of this hysteresis is subject to variation from several causes, as the magnitude of the stresses obtaining in the diaphragm at the particular atmospheric pressure, and the temperature at which observations are taken. Here, then, we have an instrumental error of a sort not to be avoided by the application of corrections, and on that account of the most adverse character. This error is common in such instruments as the Bourdon pressure gage, in which it is increased by the common practice of using brass for the Bourdon tube, this alloy having relatively unfavorable properties for measuring purposes, in the sense that its mechanical hysteresis is high.

Hysteresis a Source of Error in Measuring Instruments

Either hysteresis or its mechanical analogue, backlash, is present with startling regularity in every measuring instrument. Even in an automatic scale, where the parts may all be subject to low working stresses and may be constructed with the utmost care and nicety of fit,, the scale readings exhibit the characteristic divergence between the increasing load and decreasing load branches of the correction curve, strikingly similar to the hysteresis loop met with in the stress examination of a material. If the scale is not of the elastic-resistor type, of which the spring scale is an example, the hysteresis loop must arise almost exclusively from non-reverting shifts and the like in the linkages. That this is the case is clearly shown in such a scale by the settling back to the initial condition which occurs when the parts of the scale are sharply jarred under load.

The effects of backlash in producing this loop have been carefully examined by the author, and, instead of being of the irregular and unaccountable type which they have commonly been supposed to be, they are shown by analysis to produce divergences in the readings of the instrument exactly analogous to the hysteresis curve for the loading and unloading of a structural material. It will not be worth while to digress at this time for detailed demonstration of these facts, but it may be said that almost every characteristic of the hysteresis phenomenon for a stressed structural material is duplicated in a mechanism containing backlash, in that the width of the loop is distinctly a function of the range of motion or reading over which the instrument has been operated—corresponding to the range of stress, which affects the width of the hysteresis loop in a stressed structural specimen—and in that the size of the loop increases with poor fitting of the parts and with excessive clearance and frictional resistances generally, as it does in the case of a structural specimen which is not homogeneous or continuous and in which we may expect to find elasticity notably imperfect.

Many Relations to the Question Need to be Investigated

The absolute regularity with which this phenomenon of hysteresis occurs in measuring instruments of every sort, and the similarity of its occurrence in the case of structural members brings strongly to considerations the need of acquiring a better knowledge of the subject. Both kinds of irreversibility are "backlash"; the one in finite dimensions and the other in infinitesimal ones. Both are characterized by slips and shifts of the component parts of the structure or mechanism. In the one case perceptible mechanical wear occurs; in the other more or less gradual destruction of the tenacity properties or of the shape or dimensions of the specimen.

In order to make more evident the broad relation of this question to mechanical problems, let us consider one or two simple applications. The so-called fiber reproducer needles, often used on graphophones, are distinguished for the softness of their tone. Consideration shows, however, that there is not only a softening of the tone but a loss of some of the tone components, since, if the needle were directly elastic, practically all of the energy represented by the undulations in the record disc would ultimately reach the reproducer diaphragm and there be transformed into audible sound. This is not the case. The fiber needle does not transmit all of the energy which it receives from the record groove, but damps out much of it, owing to the imperfect elasticity of the fiber. This not only reduces the volume but also modifies the complexity of the tone and impairs the accuracy of reproduction. At the same time that such a needle reduces the scratching noises originating at the needle tip, it also eliminates certain desirable elements of the tone, namely, the high frequency overtones. This is the result of hysteresis in the material of the needle.

Aeroplane Shock Absorbers Should Have High Hysteresis

Recently certain samples of felt were to be examined with regard to their suitability for use in shock-absorbing parts of aeroplanes. At once the question was raised as to how the properties of the material which would make it suitable for this purpose could be defined. Were the material perfectly elastic, the only way in which it could diminish the effects of a severe blow would be in transforming a shock or vibration of low frequency into numerous vibrations of high frequency, the effect of which would be less destructive to life or material.

This is, in fact, the principle upon which automobile shock absorbers of the most common type operate, in that springs of high flexibility are so coupled with the springs supporting the body of the car as to dissipate in vibrations of higher frequency, the large displacements of the regular springs. On the other hand, were the material in question perfectly inelastic (or plastic), it could only perform its function once, since its first use would deform it to a condition in which it would act as a mere transmitting medium incapable of absorbing further contributions of energy.

Dashpot Action in Shock Absorption is a Desirable Quality

After these considerations we may ask what are the desirable properties of a felt material to be used as shock absorbent. It should have hysteresis of a large enough order to absorb rather than to transmit much of the energy of a blow, but it must have elasticity enough so that it will not fall short by too great an amount of returning to its initial bulk after being subjected to such a blow. Moreover—and this is a distinct and perhaps equally important phase of the question—the felt may absorb energy at once by its deformation, giving it out again only after the lapse of a more or less protracted interval of time: this is the time factor in elasticity.

This is analogous to a second type of automobile shock absorber—that in which a dashpot is used, in which the stiffness in one direction is slight and practically independent of time, while in the other direction, though the stiffness may be similarly small in amount, it is governed by the restriction that the rate at which energy is restored is limited, to the end that the mechanism returns to its original position only after the lapse of a considerable time. A common form of dashpot, in which the piston carries valves opening in one direction only, is an example of such an arrangement for shock absorption. It is analogous to a structural member having small hysteresis but extremely large time lag in its deformation for a particular sense of load application.

The question of time lag, commonly known as elastic after effect, is closely associated with the study of hysteresis. This is exemplified by the fact that in the more elastic materials, such as rubber, which is much used as a shock absorber in bumpers and the like, the hysteresis loop is subject to variation in its area and form, dependent upon the rate at which stress is applied and the time elapsing between alternations of stress. Neither property can rightly be investigated without reference to the other.

The author ventures the opinion that in this field much of striking interest and value to the engineer can be developed by moderate expenditure in research. It seems reasonable even to suppose that the most important results to be gained in the field of materials research are to be sought in this direction.

Owing to high cost, the tenders for the construction of a storage dam at Lake Brule, ten miles from Beaupre, P.Q., have been returned. The work was for the Quebec Streams Commission, the dam consisting of a wooden crib dam filled with stone and two small earth dams. The estimates proved to be higher than were expected, and the work has consequently been postponed.

Mausoleum for Mount Pleasant Cemetery

IN the southern portion of Mount Pleasant cemetery a mausoleum is being erected for the Toronto Burying Grounds Trustees, by Witchall & Sons. It is said the completed structure will cost in the neighborhood of $1,000,000. It will contain 1.228 crypts, with 21 private room crypts, provision being made for further extension,

Operations on the site were started in June, 1917. The size of the building is 223 feet long by 110 feet wide. The type of construction is granite facing outside over reinforced concrete. The concrete is lined with hollow tile faced with marble. The floor slab is reinforced concrete. The building faces towards the west where the main entry is located.

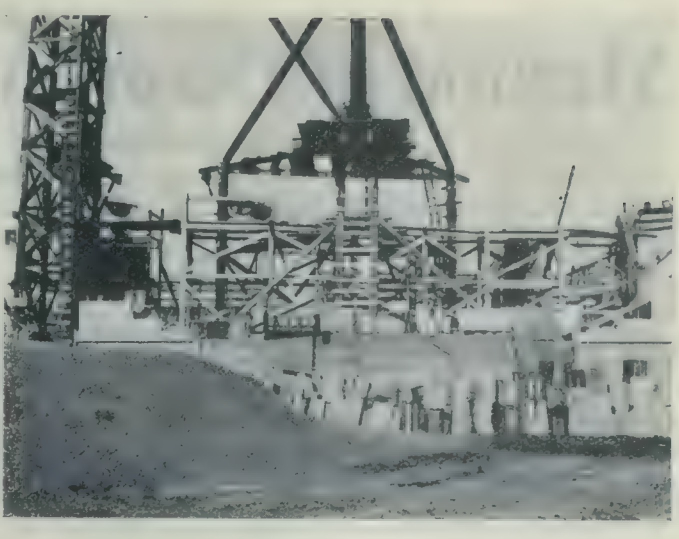


Fig. 1—View of main entrance.

The walls vary from 18 in. to 22 in. in thickness. The outer face of the wall is composed of granite stones 6 in. to 11 in. in cross section and running up to 4 tons in weight. These are placed by 4 ton derricks. Hollow tile is used on the inner face of the wall, the space between it and the granite blocks being filled with concrete of a 1:2½:4 mix, reinforced with twisted rods spaced at 18 in. The concrete is handled by the usual hoist and dump car methods.

At the present time the walls are about 75 per cent. completed, while the crypts are about to be placed. The floor slab consists of reinforced concrete varying from 4 in. to 8 in. in thickness, reinforced at 4 in. to 7 in. centres.

Up to date over 43 cars of granite have been placed on the job, while over 20,000 cubic yards of concrete has been poured.

The crypts will be constructed to be contained in the building instead of the usual method.

Darling & Pearson, of 2 Leader Lane, are the architects. The granite is being supplied by the McIntosh Granite Co., Limited.

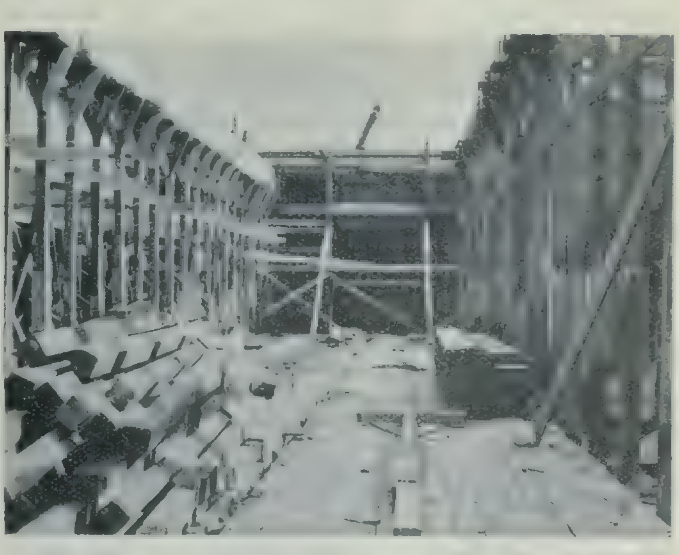


Fig. 2—Floor view looking south

Method of Determining Pile Resistance

Calculations for a Group of Piles Driven in Different Directions

WHERE piles forming a group are all driven vertical and in the same plane, it is a simple matter to determine the total resistance of the group, especially where the soil structure is uniform. However, owing to strata formations, it is often desirable that piles be driven in a more or less irregular manner, in order to arrive at the desired results at the least cost and in the least possible time. Mr. H. M. Westergaard, in the following paper, presented before the Western Society of Engineers, describes a method of calculating the resistance offered by a group of piles driven in different directions:—

The piles are assumed to be arranged in planes parallel to the plane of the paper, and parallel to the resultant force, R. The displacements considered are parallel to this plane and, in general, will be considered as infinitesimal. Each pile will be assumed to be hinged at its head and at some theoretical point near the lower end; thus, only axial loads will be considered as acting on the pile. The portion of the supported structure which rests immediately upon the piles will be called the "pier." It will be assumed to have the character of a solid mass, such that only small internal deformations will exist, when compared with the changes in length of the piles. The pier will be assumed to be supported by the piles only, both vertically and horizontally.

The pier and the piles taken together are assumed to constitute an elastic structure in which the displacement will, within certain limits, be proportional to the loads causing them. Such limits will in some cases proceed from the assumption that certain piles may not be designed to take tension. If, by applying the method which follows, any such pile is found to have tension, the analysis is to be reapplied with this pile omitted, as though inactive in the structure.

The action of the structure under the load is defined when the motion of the pier is known. In the general case this motion may be characterized as a rotation of the pier through a certain angle about a certain center of rotation. In special cases the displacement of the pier is a parallel motion. Such a motion may be considered as a rotation about a point at infinity. We may in all cases, therefore, speak of a rotation as characterizing the displacement. It will first be shown how the pile pressures depend on the rotation center and rotation angle; then a lemma relating to certain qualities of reciprocity will be introduced. On this basis a method of dealing with any particular case will be developed. Finally, the resistance in general will be discussed, assuming a varying resultant.

To find the pile pressures when center of rotation and agle of rotation are given, the notation used is as follows:

r = center of rotation.

ϕ = angle of rotation measured in radians.

p = distance from center of line of any pile to center of rotation. p shall be considered positive if a shortening of the pile would increase ϕ, otherwise negative.

l = length of pile measured from the assumed hinge at the top, to the theoretical point of support (at which a hinge is assumed) near the lower end.

e = shortening of pile.

EA = modulus of elasticity times cross-section of pile.

P = total pressure on any pile.

In Fig. 2 1-2 is the original position of a pile, and 2-3 the motion of the top end due to the rotation of the pile head through the angle ϕ about r. 2-4 is the shortening e. Point 5 is the projection of the center of rotation on the center line of the pile. If point 5 is considered as attached to the pier it moves to the position 6. As the displacements are treated as infinitesimal quantities, we may write: distance 6-3 = distance 6-4, hence distance 2-4 = distance 5-6, or, the shortening of the pile is $e = P\phi$ (1)

= distance of centre line of pile from centre of rotation times angle or rotation.

From formula (1) follows the expression for the corresponding pile pressure $P = p\phi EA/l$ (2)

Reciprocity of lines of resultant and centres of rotation

If the resultant, R (Fig. 3), produces a rotation about a point r, then a resultant S passing through R will produce a rotation about some point s, located on R. In other words, if R has its rotation centre on S, then S has its rotation centre on R. This applies in general to the displacements of any line element attached to any elastic structure.

A proof of this theorem will now be presented, it is based on the general theorem of reciprocity named after Maxwell and Betti[2], which states in one form that the displacement along one path caused by a unit load along some other path is equal to the displacement along the second path due to a unit load along the first path. Applying this to the present case (Fig. 3), we have the displacement of the point r in the direction S due to a unit load acting along R is equal to the displacement of the points on R in the direction R produced by a unit load acting along the line S. The displacement of r is zero when r is the centre of rotation, hence the displacements of the points on R in the direction of R produced by the force S are zero. Hence the centre of rotation s, corresponding to a force along the line S is located on R, which was to be proved.

To find the centre of rotation when the resultant force is given

The determination of the rotation centre is the first step in the treatment of any particular case of loading. Let R in Fig. 1 be the resultant force transmitted through the pier to the group of piles; r is the corresponding centre of rotation, which is to be determined. Now assume temporarily that the pier rotates through a certain angle about the point a chosen anywhere on the resultant R. This rotation would produce certain deformation in the piles. The corresponding pressures on the piles may be found by Formula (2). These pressures compose the resultant

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[2] Mathematic Theory of Elasticity, by H. E. H. Love, page 170, 1906.

A. By virtue of the above quality of reciprocity between lines of action and centres of rotation, the centre of rotation r will be located somewhere on A. We will then choose another point b on R, and find in the same way its corresponding resultant B. The actual centre of rotation r is the point of intersection at A and B.

In Fig. 4 the auxiliary resultants A and B are found by drawing the funicular polygons α and β. The corresponding force polygons A and B are shown to the right in Fig. 4. The piles are in this case assumed to be of equal length, cross section and modulus of elasticity. Then owing to formula 2, the pressure used in the force polygons A and B may be measured as prop'l to (for instance half of) the distances from the respective centres of rotations to the centre line of the piles.

To find the pile pressures when the resultant force and the centre of rotation are known.

Having determined the centre of rotation r, it will not be difficult to find the distribution of pile pressures. Assuming arbitrarily some angle of rotation ϕ, about the center of rotation r, a set of corresponding pile pressures proportional to the real pressures may be found by Formula 2. A force polygon gives the corresponding resultant R_1. In Fig. 4 the piles were assumed of equal length, cross section, and modulus of elasticity. Accordingly, the pile pressures in the force polygon R_1 are taken as proportional to (half of) the distance from r to the center lines of the piles. The force polygon for the real pile pressures is to be found in Fig. 4 by magnifying the force polygon R, in the ratio of R to R_1.

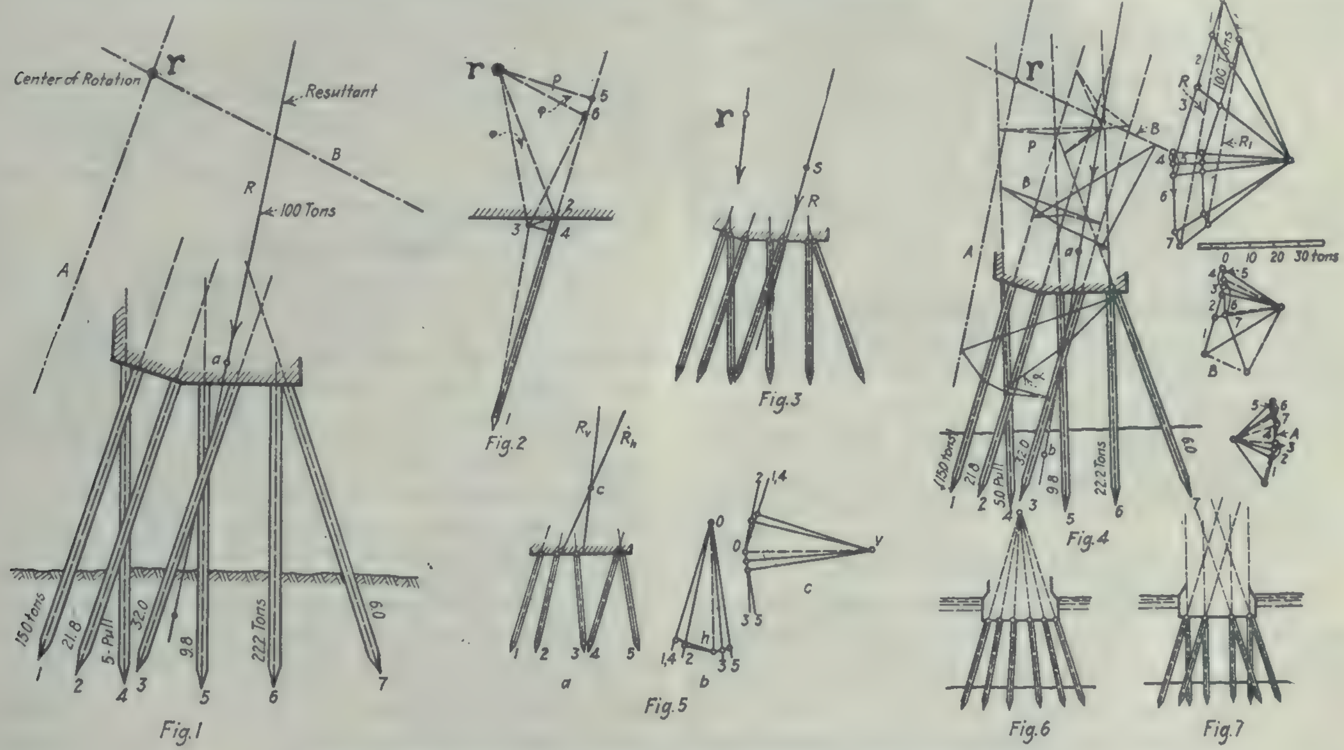

Diagram for determining distribution of pressure among an irregular gronp of piles.

Special Cases: Parallel Motion. Forces Applied Forming a Couple. Center of Elasticity

With special location of the force R, the lines A and B in Fig. 1 may become parallel. In that case the centre of rotation would be at infinity and the motion of the pier would be a parallel motion perpendicular to the lines A and B. The shortenings, or elongations of the piles due to parallel motions of the pier may be found graphically by the method shown in Fig. 5 (a, b and c). Fig. 5a shows the group of piles and the pier under consideration. To find the effect of a unit horizontal motion of the pier layout O — h = unity on a vertical line, as shown in Fig. 5b. Draw through 0 lines parallel to the piles 1, 2, 3, 4, 5 in Fig. 5a. A motion toward the left will shorten piles 1, 2 and 4 and elongate piles 3 and 5. The total shortenings and elongations of the piles are found as the distances in Fig. 5b from point h to the lines parallel to the piles. That this is correct will be seen by changing Fig. 2, in the following way: Move the rotation centre r to infinity in vertical direction, make 2-3 horizontal and equal to unity, then 2-4 will continue to represent the shortening of the pile. By turning triangle 2-3-4, 90 degs., clockwise, we reproduce the part of Fig. 5b, which corresponds to one pile.

Pile shortenings due to a unit vertical parallel motion downwards are found in the same way in Fig 5c. 0-V is a horizontal vector equal to unity. The pile shortenings are equal to the distances from the point V to the lines 1, 2 and 5, through point O, parallel to the piles.

The shortenings of the piles determine the pressure on each pile by the usual formula (2).

Each set of pile pressures may be composed into a resultant, for instance by drawing a funicular polygon. In this way the resultants Rh and Rv in Fig. 5a are found; they correspond to the horizontal and vertical translations, respectively. Translations in other directions than the horizontal and vertical may be treated by the same method. In all cases resultants passing through c will be found.

Another important case is that in which the resultant load is a couple. This case will appear to be closely related to that of a parallel motion; in fact the two cases are in some respects reciprocal. Assuming that the resultant is a couple; this may be interpreted as the limiting case in which the resultant force is at infinity. Then it is possible to apply the method illustrated in Figs. 1 and 4. We assume that R in Fig. 1 moves out to infinity.

The two auxiliary centres of rotation a and b may be chosen as the point at infinity in the vertical and horizontal directions, respectively. Assume that the group of piles under consideration is that shown in Fig. 5. Then the lines of action A and B corresponding to the rotations about a and b will be the same as Rh and Rv, the lines of the resultants producing horizontal and vertical translations. Their point of intersection c is the rotation centre when the resultant is a couple. Instead of using the horizontal and vertical translations, any other two directions might have been introduced in determining c. The relation between the moment of the couple and the corresponding angle of rotation is found by first determining the pile pressures for a certain angle of rotation, using the usual Formula (2), and then composing these pressures into a couple.

It is evident that the point c is of particular importance in defining the general elastic qualities of the structures. It is the point through which the resultant must pass in order that a parallel motion shall take place, and it is the centre of rotation when the resultant is a couple. Following the teminology used in Ritter's theory of the ellipse of elasticity, it will be referred to as the centre of elasticity. It is conjugated to the line of infinity as in Fig. 1, point r is to R, a to A, and b to B. It is also seen that the centre of elasticity is essential in defining the inter-relation between the cases of parallel motion and that in which the resultant is a couple.

General Elastic Qualities of the Group of Piles

The elastic qualities of the group of piles as a whole may be described by the following characteristics:

The centre of elasticity (c in Fig. 5a).

The resultant Rh, corresponding to a unit horizontal translation (Fig. 5a).

The resultant Rv, corresponding to a unit vertical translation:

The couple necessary to produce a unit rotation about the centre of elasticity.

It is worth noting that Rh and Rv must be known both in magnitude and direction. Owing to Maxwell's and Betti's theorem of reciprocity, they are inter-related in that the vertical component of Rh is equal to the horizontal component of Rv.

The general state of elasticity of the group is defined by these data because any resulting load may be decomposed into components along Rh and Rv, and a couple. Each of these three component loads may be treated separately, as causing, respectively, a horizontal translation, a vertical translation, and a rotation about the centre of elasticity.

Reference is made to three general methods of treating such cases of elastic resistance:

First, the method of the ellipse of elasticity, developed by Ritter.[3] The centre of the ellipse is the centre of elasticity, and force and centre of rotation correspond as anti-polar and anti-pole.

Secondly, the application of Land's Stress Circle[4] should be mentioned. This method gives information about the elastic displacements of the centre of elasticity due to resulting forces in varying direction. The method is convenient in graphical analysis.

Thirdly, attention is called to the use of a linear vector-equation (dyadics equation) in representing the relation between the displacement of the centre of elasticity and the magnitude and direction of the force applied.[5]

Any of these three representations bring out the principal axes of the elastic resistance; that is, two directions perpendicular to one another, having the quality that forces in these directions produce motions of the centre of elasticity in their own direction.

Classification of the Method Applied

If there are more than three rows of piles in the group the structure is statically indeterminate. It is treated by determining certain displacement qualities, say, two coordinates of the centre of rotation, and the angle of rotation. In primarily determining replacements the method is contrasted with the great number of cases in which stresses in redundant members are the variables in the equations of elasticity, and it is classified with such methods as the slope-deflection method applying to frames.[6]

In our graphical treatment the two lines A and B in Fig. 1 intersecting one another in the centre of rotation correspond to two of the necessary elasticity equations, while the solving of a third elasticity equation is replaced by the graphical determination of the magnitude of the resultant (Fig. 4, force polygons at right hand corner at top).

General Conclusions

The greater the distance between the centre of rotation and the centre line of a certain pile, the greater is the load transmitted to that pile. This explains that in Fig. 4 the second and the third pile from the left carry greater pressures than the first pile. In general, it is seen that when the piles are not all parallel the greatest pressures are likely to occur in other than the extreme piles.

Figs. 6 and 7 show two designs of pile groups supporting, for instance, a bridge pier. In Fig. 6 all pile centre lines intersect in one point c. A resultant load not passing through c cannot be resisted by the resultant of the pile pressures. Unless the pier or the piles are supported transversely such a resultant would cause an unrestrained rotation about c, and the pier would act as if it were hinged at c. The arrangement in Fig. 6 would not be adequate as an abundant support for a continuous arch system, neither would any arrangement in which the piles are approximately intersecting at one point.

Fig. 6 represents an extreme case. Now consider the design in Fig. 7. It is seen that a double rotation about any point would be resisted by at least some of the pile pressures. In this respect the pile group in Fig. 7 possesses a superiod rigidity compared with that in Fig. 6. In general, to obtain rigidity and strength with a limited number of piles in a limited space two requirements must be satisfied: First, resistance against the various components of the resultant loads is to be secured by battering a proper method of piles. Secondly, to prevent turning of the pier, points of intersection of centre lines should be at proper distances from at least one other point of intersection of centre lines of piles, and, if possible, the resultant load should pass between these points of intersection.

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[3] W. Ritter: Graphische, Statik, for instance, Vol III Ed. 1900, pp. 259-264.

[4] Robert Land. Der Spannungskreis, etc., Zeitschrift des Vereines deutscher Ingenieure, 1895, pp. 1551-1554. See also L. J. Johnson, The Determination of Unit Stresses in the General Cast of Flexure, Association of Engineering Societies, Vol. 28, 1902, pp. 251-289.

[5] See for instance: L. Silberstein, Vectorial Mechanics, 1913, p. 92.

[6] Wilson-Maney, University of Illinois, Eng. Exp. Station, Bulletin No. 80, 1915.

Repairing Fissure in a Clay Puddled Dam

DAMS built from puddled clay have been used to a limited extent in America where permanency is desired. That they have been used in France successfully as well as repaired when a fissure opened up is described by A. Dumas in Le Genie Civil:

The Marne Canal at the Saone required the construction of some important reservoirs to conserve the winter waters of neighboring water courses. There are four of them near the Langres Plateau, La Mouche, La Vingeamne or Villegusieu, La Liez and Charmes. The first two are located at the east of the canal and the last two at the west. These dams are all of clay, except the one at La Mouche, which is of stone, and this one and La Liez have been in use for twenty years.

General Features of the Charmes Dam

The Vingeamme and Charmes reservoirs were opened for use in 1905 and 1906, respectively. The processes of construction being somewhat new, a brief description of the last will be given before describing the accident to it in 1909 and the work of reconstruction. Being the most recent and one of the highest of the kind in France, it has been constructed in the most approved manner.

The capacity of the reservoir is 11,600,000 cubic meters. The form is common to most of the clay puddled dams constructed in France during the last 70 years. The up-river face is terraced with flat benches and inclined steps 1.70 meters high with 45 deg. slopes, while the benches are 1.00 meters wide with 0.10 meters' slope; giving a general 1.5 to 1 slope to the dam. The down-stream face is flatter and has a slightly concave shape, joined by three different slopes separated by benches, which is without doubt the best form for stability. The top is 17.0 meters (about 56 ft.) above the bed of the stream and the total height of the work above the lowest foundation is 26 meters, which makes it among the highest, as stated. The water level is 15.10 meters above the river bed. The top is 6.45 meters wide and the maximum width at the base is 64 meters. The length is 362 meters and 523.5 meters if the cut-offs are counted.

The dam was constructed in a series of layers of good clay mixed with 5 per cent. of fine crushed rock, each layer being puddled and rolled with a corrugated roller. The layers were 0.12 meters thick before rolling, which reduced them to 0.8 or 0.10 meters, making the earth remarkably hard and compact. Allowance was made so as to make it follow the required slopes and the layers were put in rapidly to always be on freshly puddled material. The face was paved or covered with concrete slabs 0.20 meters thick, with clay joints.

Accident to Charmes Dam

There had been no trouble with the dam until after it had been in use about three years, when the accident occurred.

On October 20, 1909, the dam showed a longitudinal fissure, a little above the top bench and following a joint in the paving. This fissure was apparently vertical and stopped abruptly at one end at section 18 against a step and increased at section 14, where it amounted to from 2 to 3 centimeters; gradually growing smaller until it reached sections 10 and 11, the total length being about 85 meters. There was also a difference in levels of several centimeters between the two edges.

The amount of the fissure increasing, it was decided to begin repairs.

Soundings showed that the fissures extended vertically into the puddled material, and then changing to parallel with the face. Other soundings showed the presence of 3 meters of loose material under the water. Above the fissure and under the loose material the puddled material was in good condition, showing it to be a slide from the face of the dam.

When the trouble occurred there was 6 meters of water inside the dam and it was being emptied at the rate of 0.17 meters per day. This was the lowest since it had been in use, and the lowering was reduced as much as possible in order not to remove the pressure from the face of the dam, but the sliding kept on daily. While the pressure of water prevented a complete examination it was not deemed best to empty it, as it might increase the trouble. Each day the face of the dam above water took a more vertical shape, but the worst damage was below the water surface.

On October 25 the condition was examined by a diver, who found the paving on the two lower steps opened up so he could thrust in his arm. The sliding did not stop until December 11, or 52 days after first seen. The maximum amount was 4 meters where the dam was 14 or 15 meters high. Systematic soundings were made and revealed more nearly the amount of the damage. The matter of repair was thought to be a very particular matter and investigation was made of the resistance of similar works and of other experiences. The results of the engineer's investigations are given in a memoir in the Annales des Ponts et Chaussees.

Method of Repairing the Dam.

The amount of the slide on the Charmes dam was about 20,000 cubic meters, as shown by the measurement made in 1909. It was decided that the repairs would be made of the same clay compacted by the same process to a proper hardness, and for security it was decided to reinforce the lower part 2.50 meters above the cut-off wall, the foundation of it being considered perfectly good. Two other conditions were adopted, first, the physical improvement of the Charmes clay by the addition of a considerable amount of small pebbles; second, the construction of buttresses in the reinforcements.

Stiffening the Clay by Addition of Small Pebbles

The necessity of adding pebbles to the clay to be used for the puddled wall 14 or 15 meters high on a slope of 1.5 to 1 was determined upon, which plan had been used at the Liez dam, and, probably on account of which it has stood for 25 years; and was used in the Wassy dam repairs. Such a mixture is very much superior to any other for puddled material for dams.

There being no pebbles or gravel in the vicinity, it was necessary to resort to crushed stone which was a valuable material and could not be used wastefully. Experiments were made to determine the proper amount to be used and 20 per cent. was finally adopted as best.

Buttresses Added to the Dam

The addition of buttresses was considered necessary, and it was decided they need not go all the way up the face of the dam, as insisted upon by some contractors, but only be carried up to the height of the danger zone or 8.9 meters above the top of the cut-off wall. They were 1.4 meters thick and averaged 15 meters in length. They were built of concrete similar to that employed in like work. Where they join the cut-off wall they are enlarged in the form of a girder, thus approaching the form of a solid of equal resistance.

Particular precautions were taken to prevent "water ways" where water would follow the junction of the puddled material and the concrete masonry, so the buttresses were put in at a time and in a manner that they would not interfere with the rolling of the puddled material. The plan for the restoration comprised a complete drainage system from the top to the bottom.

The paving or slabs were made by crushing the broken ones from the former work, using an excellent sand to make the concrete. The new top step was an improvement over the old.

The repairs were made from 1909 to 1911 and were quite difficult, as the year 1910 was unfortunately very rainy. The cutting away of the slide and old face was done in the first six months and all the work was carried out under considerable difficulty. The total cost of the work was 500,000 francs.

The Charmes reservoir was put in service again in the fall of 1911 and it was filled to the maximum height in three months. During the season of 1912 the water was lowered 5 meters, and neither then nor since has there been any indications of trouble; so it is believed the safety is assured under every condition.

Sewage Treatment on Niagara River

Preliminary Findings Regarding Remedial Measures — Local Conditions Present Difficulties

SOME details pertaining to sewage treatment, present and prospective, on the Niagara River district are contained in the report of the Sanitary Engineer of the International Joint Commission on Remedial Measures. It is stated that the findings represented are preliminary in nature and can be used to indicate the direction of subsequent work. The report has been prepared with a view to eliminating the dangers which are naturally associated with the present discharge of raw sewage into the river.

The conditions which obtain along the Niagara frontier are not favorable to the economical building of sewage works. The river, with its tributaries, is the universal outlet, this making necessary the construction of marginal sewers in order to intercept all pollution. This not only often requires construction in the most fully developed sections, but also places some of it below ground-water level. Furthermore, the very slight north and south slope of the ground makes proper sewer grades at reasonable depth almost impracticable, and in many cases leads to the introduction of pump set-ups in the grade. From the treatment point of view the difficulties are ground water and the expense of the land, for in all cases the works have been located adjacent to the river, not only to secure convenient outlet, but also to conserve pumping; this latter feature in all cases makes the more costly land the more desirable. The foregoing notes apply to communities above the Falls.

Combined System Used at Niagara

Niagara frontier sewers are all built upon the combined principle; that is, at time of normal flow, they carry only domestic and manufacturing waste, but in time of storm, the flow is increased by the storm water. This accretion of flow dilutes the dry weather flow, but the first wave carries with it much foul matter in the form of dust and street sweepings; also the first rise of water in the sewer washes down previously stranded solids and scours out the deposits of the low dry-weather velocities. The problem then is to determine how much of this first flow should be diverted, and the solution is obscured by the complex manner and timing of these waves, which depend among other factors—the area and shape of the drainage district, the intensity and duration of rainfall and the direction in which the storm moves. Table I records the provision which has been made in the case of Niagara River towns.

Considerations in Design

Interceptors have been proportioned to meet the needs of the year 1950, which has been assumed as the ultimate date to which present day studies can apply.

Table I.—Interceptor capacities, Niagara River District

	Average water consumption, present, G.C.D.	Sewage flow, G.C.D.[1] Average	Maximum
Buffalo, N.Y.	324	277	482
Niagara Falls, N.Y.	440	360	[2]534
Niagara Falls, Ont.	312	373	512
Tonawanda, N.Y.	583	400	600
North Tonawanda, N.Y. ..	452	400	600
La Salle, N.Y.[3]	107	100	350

The treatment works, excepting grit chambers, have been designed for a capacity adequate for 15 years to come.

The sizes of screens have been selected upon the commercial ratings of the Riensch-Wurl type, to care for the flow, and with sufficient units to insure that in case of the breakdown of one, the balance of the plant will not be subject to more than a 75 per cent. overload at times of dry weather flow. The screen house has been proportioned to accommodate one additional screen of the largest size.

In the smaller towns, fairly shallow tanks of either circular or rectangular plan have been recommended, because of the high level of the ground water.

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[1] Includes infiltration.

[2] Nominal; tunnel sewers with capacities greater than shown.

[3] Sanitary system—small town.

Table II.—Niagara River District sewage treatment—Comparative costs and efficiencies

Type of Treatment.	Per cent removal. Organic matter.	Pathogenic bacteria.	Annual per capita charges. Fixed.	Operation.	Total.
Coarse screen and grit chamber ...	0	0	......	......	......
Fine screens with prior coarse screening	10	15	$0.110	$0.183	$0.293
Imhoff tank—1-hour detention with prior coarse screen and sludge beds	25	35	.080	.147	.227
Imhoff tank—2-hour detention, coarse screen and sludge beds	30	60	.126	.147	.273
Disinfection, fine screens, detention tanks, coarse screen	20	98	.137	.446	.583
Disinfection, 1-hour Imhoff tanks, screens and sludge beds	25	98	.096	.329	.425
Disinfection, 2-hour Imhoff tanks, coarse screens and sludge beds.	30	98	.142	.329	.471
Contact beds, coarse screens, 2 hour Imhoff tanks, sludge beds	60	80	.116	.192	1.352
Sprinkling filters, 2-hour Imhoff tanks, secondary tanks, sludge beds, coarse screens	60	90	.71	.225	.935

The upper compartment has been designed to retain 120 per cent. of the average rate of sewage discharge for a period of two hours. Sludge storage has been provided to the extent of either 1½ or 2 cubic feet per capita. This allowance made was deemed sufficient to permit of retention of sludge over the non-drying winter months. The cost of Imhoff tanks of a one-hour detention period is shown in Table II.

For the larger cities, sludge bed estimates have been based upon one square foot, net, for every three persons. In other places the provision has been two square feet for five persons, the difference representing an estimate of the probable difference of expert control leading, in the larger installations, to ripe and better sludge. For tank effluents, calcium hydrochlorite at the rate of five parts of available chlorine per million parts of sewage has been allowed, the dose being applied just before entry into the tank. The application for screened sewage may be increased to allow for reduction of solids.

Mechanical Plants

In selecting the pumping machinery, no reserve apparatus has been included, but in all cases the units are such as to permit of considerable overload in the case of the breakdown of one part; and, being designed for maximum rates, it will be possible to install minor repairs without interference to operation.

Table III.—Approximate unit prices, Niagara River District

Item	Range	Approximate average
Excavation, trench:		
Earth	$0.60 to $1.50	$1.25 per cubic yard
Rock		$3.50 per cubic yard
Excavation, treatment works, earth	$0.30 to $2.25	$1.75 per cubic yard
Brick masonry in sewer...		$8.50 per cubic yard
Concrete masonry in tanks	$6 to $21	$10 per cubic yard
Vitrified pipe	65 per cent. to 75 per cent. off list.	
Manhole		$5.50 per vertical foot.
Timber sheeting	$15 to $25 per M ft. b.m.	
Steel sheeting		$32 per ton
Cast-iron pipe		$30 per ton.
Repaving, asphalt and block	... ...	$2.50 per square yard.
Buildings	$0.10 to $0.20 per cu. ft.	
Engineering		7 per cent.
Profit and contingencies.	15 per cent to 50 per cent	

In most cases the elevations are such as to make necessary the pumping of sludge from the tanks, and to meet this condition, it is expected that the air lift will be employed, calling for the installing of an air compressor. Table No. III. shows the results of investigation in the field of unit costs.

Metric System Simplifies Surveyor's Work

THE merits of the metric system have been discussed pro and con for many years. It is conceded that the English units in the main are more difficult to manipulate, but as against this there is the fact of its being the established system in all manufacturing organizations where its replacement by the decimal system would mean a very large capital expenditure. As the metric system comes to be understood, however, there is undoubtedly a growing desire for its adoption if, and when, this may be possible. In England the discussion at the present time is losing none of its interest on account of the war, and, indeed, the more intimate commercial relations between England and France have probably done much to emphasize the advantages of the latter country's system.

No single class of people in the Empire is, perhaps, more intimately interested in our notation system than the surveyor. The land surveyor's chain, etc.

The land surveyor's chain of 22 yards is divided centesimally into 100 units, each of 7.92 inches; it was introduced by Edward Gunter in 1620, but only authorized by Order in Council on June 27, 1876. For levelling, that is to say, for vertical work, surveyors use the centesimal part of a foot. These usages, some of 300 years' standing, and the fact that in towns they use a chain of 100 feet, demonstrate that surveyors have always preferred to work with a decimal system, and they admit that even this partial adoption of some method of tens has helped immensely. But it would help in many calculations if the lineal measures were decimal and the square measures centesimal instead of the reverse being the case. Thus the side of an acre is the square root of 10 square chains, or of 100,000 square links, and the square roots of these figures are not whole numbers in either case.

The following examples, taken from a paper by Lieut. A. J. Martin, F.S.I., read before the Surveyors' Institute, further illustrates the inconvenience of the present units used by surveyors:—

A fall of 8 feet per mile is 1 in 660, which requires quite a mental effort.

A fall of 1 in 600 is 1 foot in 9.09 chains—rather appalling figures.

1,597 inches equals 2 chains 0 yards 1 foot 1 inch, but no association of ideas carries the mind from one set of figures to the other, whereas it is seen at a glance that their metric equivalent of 40,564 millimeters is also 40 m. 564 mm.

Although the centesimal foot has certain advantages, it is a pity our horizontal and vertical measures and scales should not have a common basis.

There are no square furlongs and no lineal roods.

The side of a square-shaped acre is about 208¾ ft.

If the International system is adopted by us we could have a chain of 20 meters in length (equal to 21.87 yards instead of the 22 yards) divided into 200 links of 1 decimeter, or 100 links of the double-decimeter (equal to 7.87 inches against 7.92 inches in the link), and probably we should carry 5 pins instead of 10; and for levelling we should use the centimeter (equal to 0.39 inches) instead of the 1-100th of a foot (0.15 inches), the former being a much more convenient unit for the sight, as the sample levelling staffs show. The centimeter levelling staff has been made in this country for many years for exporting to foreign countries and to some of the Oversea Dominions.

Thus our land surveying and levelling units could be metric throughout, and agree with the units of length to be used in all other trades and professions.

Ordnance Maps

Land surveying brings us to the question of our ordnance maps. Our original ordnance survey is known as the "parish map," the 1.2500 as some call it, as it is to the scale of 1 meter to 2,500 meters, or expressed in another way, 4 decimeters to the kilometer. And the new town maps are to the scale of 1.500, or 2 meters to the kilometer. These scales were decided upon at the International Statistical Conference, held at Brussels in September, 1853.

Yet what do we do? We do not even show an international scale on our maps, but only the reference fraction 1.2500, which the foreigner at once recognizes as metric. But we indiscriminately—criminally, I nearly wrote—describe them as to the scale of either: —Parish map (a) 1 inch to 3.156 chains; (b) 1 inch to 208.3 feet; (c) 1 inch to .0395 mile; or (d) 25.344 inches to 1 mile. New town map (a) 1 inch to 41.66 feet; (b) 126.72 inches to 1 mile; or (c) 10.56 feet to 1 mile; and then, as though still further to hide the fact from the British people that the maps are really metric, we have the "sheet lines" (to use a technical expression for the lengths which the sides of the map represent) to British denominations.

Maps made from the parish and new town maps of a naval base, show plainly that our original ordnance maps are metric, and how the sheet lines could be adjusted to metric measures if desired. I chose this example of a naval base years ago as a warning, and since writing the draft of this paper I have heard that that naval base has been bombed. How easy when the flights are by kilometers and the maps of the land below are in kilometers, and when we surveyed the land for the enemy and plotted them to their scale, which we have so far not adopted for ourselves! If a foreign army were landed in this country all the sightings of the enemy's big guns, rifles, etc., would be to the same system of measures as our maps. But with us they would be different, and the scales on our maps are so complicated that, in our own country and with our own maps, we shall be more liable to errors regarding distances that the enemy would be. And yet the primary object of our maps was for military purposes, as the name "ordnance" indicates.

The parish and new town maps are photographed down to smaller scales, by complicated mathematical calculations, to the scales of 6 inches to 1 mile, 1 inch to 1 mile, and so on, until almost all trace and remembrance of the international system is obliterated and forgotten by the British, but not by the enemy.

It should be noted that scales such as 10 inches or 10 feet to 1 mile are not decimal scales, as the inch and foot are not decimally related to the mile. A decimal scale is 1 of any unit to 10, 100, 250, etc., of the same unit, and such a scale makes it possible to use the map to any unit whatever of any country.

Further, we have had the full use in this war of the maps, for example, of France and Belgium to international scale. What have we done with them? Drawn lines across them showing blocks of one square mile and decimal divisions of the mile (1,760 "yards"), and so on. Yet the reports come to hand, "We have advanced x 'meters' on a frontage of y 'kilometers.'" The plain business man would describe all this confusion as a muddle. Are our guns sighted to fit in with decimal divisions of a mile or to chains? No, but in 100's and 1,000's of yards. And yet an approximate 10 per cent. change of the old sights would have given meters (all sights of new guns could have been made metric), and we should not have had to waste time altering the French and Belgium maps.

Another question may be asked. If all our principal ordnance maps are really metric, how could we show the same thereon in metric denominations? Once more the answer is simple. Present areas are shown in acres and decimal parts; printed conversion tables could be issued as in the old days, when land agents troubled to convert decimal parts of acres to roods and poles, and on all reissues of the sheets the metric areas would be inserted instead, and metric scales shown on the maps. In the meantime an approximate rule would be to multiply by four and point off one place to bring to hectares. Tenants of estates would perhaps receive from their landlords revised schedules of their lands, and when wishing to grub up hedges, etc., so as to make their fields more suitable for motor ploughing, would, where just as convenient, replant now boundaries so that convenient metric areas were enclosed.

Contour Lines

The contour lines on our maps are generally shown at intervals of 50 feet, 100 feet, or 200 feet, equal in metres to 15.24, 30.48, and 60.96. These intervals do not affect our commerce, farm work, etc., and therefore this is less important, but I suggest that when the maps are revised, by rotation which occurs about every 20 years normally, intervals of 25 and 50 metres should be used. The contour lines are mostly sketched on by experts, all of whom could just as readily sketch on the new intervals; in fact, surveyors or the militia could generally calculate for themselves from the existing lines where the metric intervals come. These vertical intervals are important for artillery and machine-gun work, and we may rest assured that the Germans have placed such vertical intervals on our metric maps for their use if occasion arises.

Montreal Works Department Reorganized

The Administrative Commissioners of the city of Montreal are putting into effect extensive changes and reduction of staff. On the recommendation of Mr. Paul Mercier, chief engineer, who in future will be known as the director of public works, this department is to be entirely reorganized; four hundred employees are to be dispensed with, which will enable a saving of $400,000 to be made. Four divisional superintendents will be replaced by a general foreman, while the four divisional engineers will be centralized at the City Hall, a portion of their staffs being let out. It is understood that there will be some changes in the Roads Department, and that many inspectors will be dismissed.

The public works committee of Quebec City has decided to spend a sum of $61,039 on paving improvements. The repairs and improvements are limited to what is absolutely necessary throughout the city.

New Method of Cleaning Catch Basins

Employs Centrifugal Pump Mounted on Motor Truck—Saving in Time, Labor and Expense

THE city maintenance department is at present greatly inconvenienced due to lack of labor, especially in the various street cleaning divisions. It has always been more or less difficult to secure men for cleaning catch basins, and in order to dispense with the need for men in this work, a machine has been invented, which, it is said, executes the work in a most satisfactory manner at a minimum cost. The main features are described in the following article in Municipal Engineering:—

A 4-inch telescopic pipe, with a horizontal discharge branch at the top has at its lower end an elbow connected to a 3-inch pipe from which a hose is led to the discharge of a centrifugal pump. A 1-inch nozzle from the 3-inch pipe is led into the 4-inch pipe, where it is turned upward. The 14-inch centrifugal pump is mounted on the side of the truck frame and its suction is connected to the body of the truck. It is driven by a link-belt chain from a power take-off attached to the driving shaft of the truck. The sprocket on this shaft runs idle normally and is engaged by means of a lever near the driver's seat. A pressure gauge enables the driver to regulate the motor to give the proper speed and pressure at the pump. The ratio of the sprockets is such that the required pressure of 40 to 50 lbs. is obtained at a low motor speed. The body of the truck is a watertight steel box. Its tail gate is hinged at the top and is made watertight by means of clamp bolts which press a rubber gasket against the end frame. An opening in the bottom provides for the attachment of the inlet valve on the pump suction, and an opening in the side provides for the overflow valve. Within the body is a frame carrying transverse hinged baffle plates, and having a longitudinal partition plate extending the full length of the body. The 8½-inch space between this partition and the side of the truck is called the clear-water compartment. The first three baffles extend only to the partition and have openings in the upper portion so spaced as to cause the flow of water and refuse to travel far. By this means most of the solid matter settles before the flow reaches the end baffle. This last baffle plate extends the full width of the body and is pierced with ¾-inch holes. Thus the flow is screened as it passes out of the main part of the body and again as it enters the clear-water compartment, with which the pump is connected. Spacers hold the baffles in position when the tail gate is closed. The opening of this gate releases the spacers so that the baffles can swing back and give free discharge to the contents as the body is dumped.

The machine can be converted into an ordinary truck for handling stone, gravel and other material. For this purpose the bottom is made of heavy plate, the baffle frame is removable and the two valve openings can be closed by bolted covers. In starting its work the truck, with body partly filled with water, is run close to the catch basin. The educator arm is loosened and run out to position over the manhole and then the telescopic pipe is lowered until it rests on the refuse in the catch basin. The pump is then started, drawing water from the truck body and discharging it into the 4-inch pipe through the 1-inch nozzle at 40 to 50 lbs. pressure. This upward jet causes the refuse to flow into the pipe, where it is carried up and discharged into the truck. There the solid matter settles and the water comes back through the clear-water compartment to the pump.

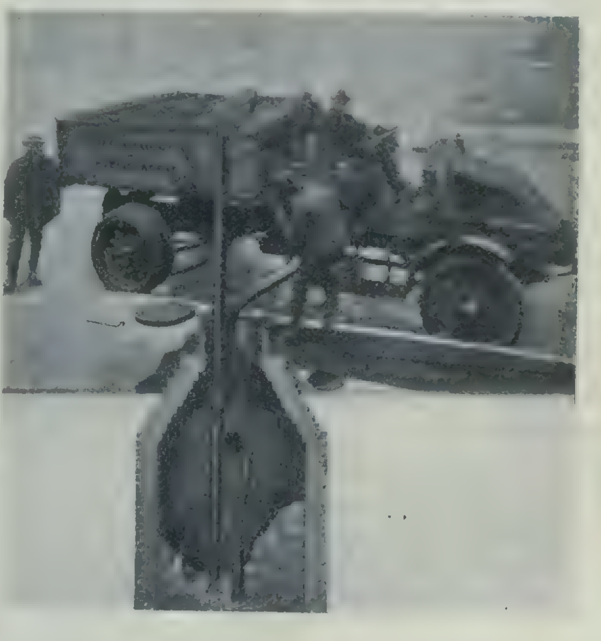
Cost of Operation

One chauffeur, 3 months at $115 per month	$345.00
One laborer in charge of auto crew, 2 months at $3.60 per day	176.78
One laborer in charge of auto crew, 1 month at $4.60 per day	112.95
One laborer in charge of auto crew, 3 months at $3.30 per day	243.08
Total for labor	$877.81
Repairs, gasoline, oil, etc.	$308.08
Interest at 4 per cent. on $7,000 (cost of machine),	70.00
Depreciation at 10 cents per mile for 1,380 miles	138.00
Grand total	$1,393.89

Work Performed

Number of miles traversed	1,380	
Number of catch basins cleaned	1,073 at	$1.299
Number of cubic yards removed	1,763 at	.79

The average cost for cleaning catch basins during the past four years was $3.24 each. Using this price for comparative purposes it appears that the city has saved $2,082.63 upon the work performed by the pump during the three months of operation.



In March, 1918, Chicago purchased six more of these machines; this increase in equipment is the result of the above record of performance.

During the first six days one of these machines was operated in Louisville, Ky., by a driver and two laborers unfamiliar with it, it cleaned basins at an average cost of 69 cents each as compared with $3.40 by hand. The sanitary advantages of the machine were equally superior to the results secured by hand methods. During these days, in freezing weather, an average of 25 basins were cleaned in nine hours. This figure, it was expected, would be increased to 75 after the first thorough cleaning.

At Portland, Ore., the performance of the machine was as follows:

Average number of basins cleaned per day		100
Average size of basins		1½x2x4 ft.
Wages of truck driver	$3.75	
Wages of 2 laborers at $3	6.00	
Total cost per day		$9.75
Average cost per basin		.10

At Indianapolis, Ind., time tests showed that the machine could clean a basin 9 feet deep and 4½ feet in diameter, full of heavy dirt and mud to the outlet of the basin, in 8 minutes.

Montreal Builders' Exchange Suggests Contractors' Conference

THE directors of the Montreal Builders' Exchange are planning for the future. At a meeting last week the following resolution was passed:—

"Whereas we believe it is desirable that representatives of those engaged in the building business in Canada meet and formulate plans of action with respect to the future on various important matters relating to our business; and that, whereas we believe that the general building business outlook of Canada should be studied with respect to labor and material and foreign competition; and whereas new lines of contract work should be studied and put into action with the view of re-adjusting ourselves to the present world situation; and whereas it is desirable that the present methods of calling for tenders, awarding contracts, and supervision of public and private works leave much room for improvement; we, the Board of Directors of the Montreal Builders' Exchange, resolve that this Exchange respectfully suggest to the other building Exchanges of Canada and other contracting interests that a conference be held, preferably at Ottawa, during the latter part of August, or early in September, to study and discuss these matters and any other questions of mutual interest to the contractors of Canada with a view to recommending concerted action by the various Exchanges and other interested organizations; and further—that at least two members be secured from each Exchange, but that as many contractors as possible be invited to attend this conference."

The question of labor conditions was also discussed. Mr. John Quinlan suggested that the whole subject of such conditions and wages in Montreal should be dealt with at a general meeting of the Exchange. He said at present there did not seem to be any uniformity in these, and it would be well if the general contractors especially got together and compared their experiences in these matters, not only in different sections of Montreal, but also in different parts of the province. Of late years many young contractors had entered the business, and those required to be educated in the conditions now in operation, not only for the sake of their own business, but in the interests of the building public.

Mr. J. P. Anglin, who presided, pointed out that the position of the Builders' Exchange of Montreal was unique in this, that at the present time there was no agreement as to wages in operation between any labor union and any section of the Exchange. To some extent this was due to the large number of non-English firms who were not paying the highest wages. In any case there had been no real advantage in the past in Montreal in having agreements with the unions. They had been no protection, but rather the opposite. They had been broken with impunity, and his experience had taught him that in Montreal at least there was no redress.

Mr. A. Charette suggested that one reason for the inequality in the rates of wages paid in Montreal was the fact that certain firms were in the habit of obtaining work of a high class and consequently were able to pay higher wages.

Mr. Irving stated that if wages in the building trades were to be boosted, the price required by contractors for their work would have to be raised still higher. At present everything was rising in price except the cost of building. Mr. Quinlan remarked that the builder who contracted at a low price this year was going to be fooled.

The suggestion of Mr. Quinlan was adopted, that a special general meeting of the members should be held on Wednesday, June 19th, at which the present labor situation in the building trades of Montreal might be reviewed and, if thought advisable, suitable action taken.

A note from Brig. General Loomis, C.M.G., D.S.O., "In the field," was read, thanking the president, directors and members for their kindness to him during his recent visit to Montreal.

Renewing the Water System, Grand'Mere, Quebec

Mr. R. S. Lea, consulting engineer, Montreal, who was requested some time ago to report on the opportunity of renewing the water system at Grand'Mere, P.Q., has deposited his report before the board of direction of the Laurentide Co., Ltd. After a close investigation, concerning the intake and the discharge, the engineer concludes that the Giguere Lake, where is the actual intake feeding the old system, has to be preserved and that the 8-inch pipe is to be left in place as far as the Royal Road at Ste. Flore, where a pumping station is to be installed to pump the water into a concrete reservoir, capacity 500,000 gallons, sufficient to supply six hose during a five-hours' fire without using the fire pumps. This reservoir shall be placed on a hill, with a height sufficient to give a pressure of 125 lbs. per square inch in the heart of the city or on the principal street. From the reservoir to the city a 16-inch main pipe will be laid in the ground along the St. Louis Road as far as the St. Georges Street; from where the ramification of supplementary pipes will be distributed. The main pipe is designed to be approximately two miles and a half in length. The total cost is estimated to be $200,000, including the reservoir and the pumps.

After maintaining offices in the "Star Building" Toronto, for thirty-two years, Messrs. A. R. Denison & Stephenson, architects, have moved into new quarters in rooms 542 and 543, Confederation Life Building.

Mainly Constructional

East and West—From Coast to Coast

The Canada Plaster Board Company has been granted letters patent of incorporation and is locating at Brantford, Ont., its capitalization being $100,000.

Inspectors of the Ontario Department of Lands, Forests and Mines are at present engaged in making an inspection of the roads in the Gowanda silver area in Northern Ontario, to report what repair work must be done to put them in proper shape.

The permits issued in Galt, Ont., for the first five months of the year number 68 and are valued at $71,535, as compared with 48, valued at $57,130, in the same period last year. The total during the month of May was 43 permits, at a value of $53,395.

The building permit values in Welland, Ont., as reported by Building Inspector Black show a substantial increase over last year. They are as follows: May, 1918, $93,029; May, 1917, $37,846; first five months, 1918, $176,724; first five months, 1917, $133,195.

The ratepayers of Amherstburg, Ont., have endorsed a by-law to expend $100,000 on a new water supply. An arrangement has been made with the Brunner-Mond Company, which is building a large factory in Amherstburg, to erect a waterworks plant and supply pure filtered water to the town.

The property and license committee of the Hamilton city council have endorsed a plan for the reconstruction of the market hall, whereby the present walls will be utilized and a refrigeration system installed. The total estimated cost is $105,000. The new building will be 18 feet wider than the structure which was burned and will also contain 12 more stalls, the total number being 48.

The Enderton block, at the corner of Portage Avenue and Hargrave Street, Winnipeg, which was partially destroyed by fire last winter, will be rebuilt this season at a cost of some $200,000. The restored building will be practically a replica of the original and is to be ready for tenants in the fall. Mr. C. E. Enderton, the owner, has decided to have the work carried out by day labor, and has placed W. A. Irish, contractor, in charge.

The council of Truro, N.S., has decided to install a new electric light and power plant. It is proposed to abolish the present plant at Victoria Square and establish the new one at the pumping station. The cost of this undertaking is estimated at $40,000. Part of the plant at the pumping station will be used and, possibly, some of the old Chambers plant, but the great bulk will have to be new. It is hoped to have the work completed by December.

The plans of the Brantford, Ont., Board of Trade for relieving the house shortage are now materializing and a company has been formed, known as Brantford Buildings, Limited, which will acquire lands and erect dwellings for workmen. The new company has associated with it Messrs. W. N. McEachern & Sons, Limited, of Toronto, and this latter firm will handle the construction work. Other cities in Canada are also finding it necessary to take immediate steps to relieve the situation. The Galt Board of Trade has been discussing the matter and has appointed a committee to consider the best means of improving the present conditions. St. John, N.B., is also faced with the housing problem and the city council at a recent meeting passed a resolution providing for the immediate expropriation of land and the erection of such houses as may be necessary and practicable.

The permits issued in St. John, N.B., during the month of May are valued at $143,000, as compared with $16,400 for the same month last year. The $125,000 permit for an addition to T. McAvity & Sons' plant is responsible for this large increase. This new building will practically duplicate the company's present factory, its dimensions being 403 ft. x 35 ft. The total value of the building permits issued during the first five months of the year is $222,475, against $404,400 for the corresponding period in 1917.

Extensive building operations are being planned by the Royal Air Force for the Toronto Military District. It is stated that the cadets will remain in Canada next winter, instead of going to Texas, and it is intended to provide them with permanent quarters, which can also probably be utilized for demobilization purposes after the war. Plans are now being considered regarding the erection of huts at all the camps—Camp Borden, Deseronto, Beamsville, Hamilton, Armour Heights, Long Branch, and Leaside.

The Trent Canal was officially opened for navigation from Trenton to Lake Simcoe on June 3 by Hon. Dr. Reid, Minister of Railways and Canals. The waterway from the Lake Ontario outlet at Trenton to Lake Simcoe, via Peterboro, has cost in the neighborhood of $6,000,000. This section of the canal has a depth of 8 ft. 4 in. from Lake Ontario to Peterboro and from Peterboro northwards, a depth of 6 ft. 6 in. The northern half of the waterway, giving outlet to Georgian Bay, via the Severn River, will not be completed for some time yet. It will cost another $2,000,000. The canal was commenced some 25 years ago and work has been carried on in easy stages.

The work of making necessary repairs and replacing old rails on certain railway lines for which funds were provided at the last session of Parliament has been begun. The line from Port Arthur to Antikokan on the main line of the Canadian Northern Railway from the head of the Great Lakes to Winnipeg is being rebuilt in anticipation of an unusually heavy grain movement during the coming autumn. The Goose Lake branch of the Canadian Northern, serving a productive grain producing area, is being re-laid with 85-pound rails, and is being double tracked on the section which taps the Drumheller coal fields. For rail replacements some 500 miles of steel purchased by the Government are moving to the points at which they will be required.

Personals

Mr. Geo. H. Archibald, of Messrs. Archibald & Holmes, Excelsior Life Building, Toronto, has been appointed manager of reconstruction department, Relief Commission, Halifax, N.S., in place of Col. Low, resigned.

Engineer Morris Knowles has entered into an agreement with the Essex Border Utilities Commission to supervise the construction of intercepting sewers to serve Windsor, Walkerville, Ford, Sandwich, Ojibway and Sandwich West. The fee is 4 per cent. on the estimated cost, which is $210,000.

Lieut. J. W. B. Blackman, formerly city engineer of New Westminster, B.C., has finished the construction of an aviation camp in England, of which he was in charge, and is now probably in France, according to a letter from him recently received by Mr. Stewardson, who fills Lieut. Blackman's place in New Westminster. Lieut. Blackman went overseas with Major Marsh's Railway Construction Company and was loaned by the War Office for the purpose of carrying out the above-mentioned project. His letter stated that he expected to be in France before it reached Canada.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Halifax, N.S.
City Council contemplate the construction of paving costing $67,000 on Argyle and Grafton street, and tenders will be called shortly. Engineer, H. W. Johnston.

Hartland Village, N.B.
Tenders will be called about July 1 for five hundred feet of 6-inch watermains and four hydrants for the Hartland Water Corporation. Secretary, T. G. Simms.

Islington, Ont.
Tenders will be received by the engineer, Frank Barber, 40 Jarvis St., Toronto, until June 15, for the construction of sidewalks on Canning and Islington Streets for the Village Council.

Leamington, Ont.
Town Council contemplate the construction of cast iron water main and hydrants. Clerk, R. M. Selkirk.

Lethbridge, Alta.
Town Council plan improvements to sewerage plant at a cost of $3,000. Mayor, Mr. Hardie.

Shawenegan Falls, Que.
Tenders will be called next month by the clerk, J. E. Meunier, for improvemetns costing $25,000 to acqueduct for the City Council.

Tenders will be called next month by the clerk, J. E. Meunier, for the construction of a $32,000 main collecting sewer for the City Council.

The City Council contemplate the construction of concrete pavement on Station Street from C.P.R. Station to Fourth and Fifth Streets. Tenders will be called soon. Clerk, J. E. Meunier.

Welland, Ont.
The City Council contemplate the construction of sewers and sidewalks. Engineer, D. T. Black.

Woodstock, Ont.
City Council contemplate the constructionu of 8 in. glazed tile sewer on Beal Street. Clerk, Jno. Morrison.

CONTRACTS AWARDED.

Louisville, Que.
C. D. French, of Kennedy Construction Co., Ltd., 137 McGill St., Montreal, has the general contract for the construction of bituminous macadam costing $15,000 for the Highway Department, Municipal Council.

North Vancouver, B.C.
The Canadian Pipe Co. Ltd., (manager, A. G. McGregor), 550 Pacific St., have the general contract for the construction of watermains, etc., costing $24,217 for the Municipal Council.

St. Vutal, Man.
P. A. Krocker has the general contract for reinforced concrete culvert for the Town Council.

Thorold, Ont.
J. D. Armstrong, 138 Ere Ave., Hamilton, have the general contract for $3,000 sewer for the Town Council. Clerk, John S. Clark.

Railroads, Bridges and Wharves

Burford Township, Ont.
Tenders will be called July 1 for the erection of a concrete bridge for the Township Council. Engineer, R. M. Lee, 145 Drummond St., Burford.

Guelph, Ont.
The City Council contemplate the erection of a steel bridge on the Dundas Road. Engineer, F. McArthur.

Lambton County, Ont.
Tenders will be opened at Petrolia, at 1 p.m., June 17, for the erection of steel bridges for the County Council. Commissioner, J. McCallum, Alvinston.

Peterboro County, Ont.
Tenders are being received by the Clerk, E. N. Elliott, Peterboro, until noon June 19, for the erection of Robson, Dunlap and Alma bridges for the County Council. Plans and specifications are with the clerk and engineers, Bowman and Connor, 31 Queen W., Toronto.

Portage La Prairie, Man.
Time for reciving tenders for the erection of reinforced concrete bridges and culvert for the Town Council has been extended until noon June 14. Plans and specifications are with the secretary-treasurer, D. McCowan, and the Highway Commissioner, Winnipeg.

Toronto, Ont.
The Board of Control have adopted the report of the Commissioner of Works recommending a trestle bridge over Glen Road for street railway, vehicular and pedestrian use.

CONTRACTS AWARDED.

East Wawanosh Township, Ont.
A. Hill & Co., Mitchell, have the general contract for the erection of a bridge over Blyth Creek costing between $3,000 and $4,000 for the Township Council.

Halifax, N.S.
Morrison and Downing, care of Assistant Chief Engineer, W. A. Duff, Ocean Terminals, Halifax, have the general contract for transit sheds for the Canadian Government Railways, Ottawa.

Kent Count, Ont.
A. J. Coreller and C. McCreary, Thamesville, have the general contract for three reinforced concrete bridges for the County Council.

Minitonas, Man.
W. McQuay, Dauphin, has the general contract for bridge for the Town Council.

Ontario, Province of.
Walter Patterson, Belleville, has the general contract for the erection of railway stations at Trenton, Cherrywood and Uhthoof for the Canadian Pacific Railway, head office, Montreal.

Toronto, Ont.
A. Matthews, Ltd., 256 Adelaide W., have the roofing and sheet metal work for military hospital on Christie Street for the Department of Public Works, Dominion Government.

Public Buildings, Churches and Schools

Esquimault, B. C.
F. M. Rattenbury, 1701 Beach Drive, Victoria, has prepared plans for a sailors and orphans home for the Navy League, 400 Stobart Pease Building.

Esquimault, Vancouver Island, B. C.
The Esquimault School Board, Lampson St., contemplate the erection of a $45,000 high school. Chairman, Mr. Greaves.

Halifax, N. S.
Tenders will becalled shortly for repairs to "Oxford" school for the School Board, 81 Sackville Street. Architect, W. J. Busch, 60 Bedford Row.

Hamilton, Ont.
Tenders are being recived by the clerk, S. H. Kent, until June 18, for the erection of an addition to house of refuge for the County Council. Plans and specifications are with the architect, F. W. Warren, Bank of Hamilton Bldg.

Montreal, Que.
The Montreal Sailors Institute contemplate the erection of a branch institute. President, Dr. Lansing Lewis.

New Denver, B.C.
Tenders will be recived by the Minister, until noon June 21, for the erection of a school for the Department of Public Works, Provincial Government. Engineer, A. E. Foreman, Victoria.

Ottawa, Ont.
Tenders are being recieved until noon July 2, by the architects, J. A. Pearson and J. O. Marchand, Centre Blk., for lighting fixtures, and hardware for the Parliament Buildings for the Department of Public Works, Dominion Government.

Plunkett, Sask.
Plans and specifications are with the architect, Norman L. Thompson, 35 Willoughby Blk., who will receive tenders until about June 15 for the erection of a $20,000 church for the Roman Catholic Congregation.

Saanich, Vancouver Island, B.C.
The Saanich School Board, Municipal Hall, contemplate the erection of a school on Cloverdale Avenue. Chairman, M. McGregor.

Toronto, Ont.
The Bellefair Avenue Methodist Church will erect a $40,000 church on

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The Shortage of Engineers

THE United States is now beginning to appreciate one of the difficulties that we have been meetin Canada for some time, namely the shortage of engineers. In a recent letter from President Wilson to the Dean of the College of Engineering of the University of Michigan, the importance of maintaining the number of engineering students was urged. President Wilson expressed the greatest concern at the falling off in the number of students in the engining department, stating, "there is not only immediate necessity that as many students as possible should prepare themselves for engineering duties in the army and navy, but it is also of first consequence to the country that there should be an adequate supply of engineers for the period of reconstruction which must follow the war."

It was stated that the attendance in engineering classes since the United States entered the war has fallen from 25 to 35 per cent., and that the graduating classes this year were not more than half their usual size. This approximately represents the condition of Canadian colleges after a year of war, and the United States will do well to prevent the crisis which has arisen in our own universities. The fact is that in the engineering departments of both Toronto and McGill—and doubtless it is so in the other universities—the graduating class reaches the vanishing point before the course is completed. In certain of the courses where the demand for men is greatest, there are no students beyond the second year. Canadians are endeavoring to rectify this serious condition, but the process is slow and it would have been ever so much better if precautions had been taken at an earlier stage in the war.

The Contracting Business—Its Present Difficulties and Future Problems

THERE is considerable criticism of the delays and disappointments in building work to-day for which there is probably much more reason than the average citizen imagines. The building contractor is having great difficulty in keeping his organization up to the desired strength; it is a practical impossiblity to gauge costs accurately owing to over-night price changes; materials are difficult, and often impossible to get; employees are less efficient and more careless; and so on. There is no doubt that the present system of contract work and the nature of agreements could be much improved, yet it must be remembered that the contractor of the present date, in carrying out any work, more especially that requiring skill, is at his "wits end" to get the work done in any kind of shape, conforming as nearly as possible to the demands of the contract. Keeping these difficulties in view, we are of opinion that any contractor who carries out work under present conditions in a satisfactory manner should be given every consideration and due credit.

The war has called many engineers and contractors to the front, where their knowledge and special training render them of invaluable service to their country, and there are many who could not go and have entered different phases of munition work for the war period, but who, when the war is over, will return to their previous line of work. They will all be needed after the war. Also there will be many new contracting firms springing up which will require a careful rating of their ability to carry out public work. While every encouragement should be given to the young contractor the public must be protected or the reputation of not only the inexperienced contractor, but also that of all contractors will suffer. With the future in prospect, the present moment would seem to be an opportune one for contractors to organize and co-operate to make ready for the coming influx of new men into the business, as well as to help those who for the past four years have been engaged in other work and need coaching in order to brush up on present modern methods of construction.

It is only by organizing and co-operation that the status of contractors in general will be raised to its deserving level; for an efficient contractor must be a man of no mean ability and proper rating should be given those who have risen to a prominent place in the profession. Work has been held over for four years in all parts of the country. When the war is over, not only will there be at least the usual amount of new work, but also the work accumulated for four years will have to be rushed in order to bring back the country to normal condition. In other words, our maintenance has got ahead of us and, like the house which has been left to take care of itself, the final cost of repairing will be much in excess of the sum of the amounts of each annual outlay under normal conditions.

The necessity of educating new men into the contracting business will be further increased by the falling off in the number of technical graduates from all our engineering institutions. Before the war the general opinion was that the engineering profession was overcrowded; possibly it was, but the limited number of technically trained men now available and who will be required as perhaps never before, is a problem of the utmost significance in the future period of reconstruction.

Is This Departure Well-Advised?

THE Canadian Society of Civil Engineers has marked the change in name to the Engineering Institute of Canada by the initiation of the publication of an organ of the Institute under the name, "The Journal of the Engineering Institute of Canada." The first issue of this journal is interesting, but contrary to expectations, it bears all the earmarks of a commercial enterprise. One hears, among engineers and technical men generally, the doubt expressed that the Institute has not been wise in taking this course, which naturally brings them into direct commercial competition with those other Canadian engineering magazines, upon which, in the past, they have been dependent for publicity and support, and from whom, presumably, a continuation of this support would, in the best interests of the Institute, still be desirable.

Save Time by Filing Technical Articles

ALTHOUGH we all agree that practical experience in any work is an essential to becoming thoroughly proficient, yet in many phases of engineering work the only way for the contractor to keep up with the times is to follow up what has been done elsewhere. However, in these days of the ever-increasing battle against time, the busy contractor, more especially when out on the job, has not as much time to read up items in connection with the work in hand as he would like to have. In order to keep up with modern developments about the only information available is that obtained from accurate descriptions of similar work as found in his current magazine; if these descriptions of similar work, as found in his current magazine do not contain anything of practical value they are of little use to anyone.

In spite of the fact that there is an almost unlimited supply of engineering books on the market dealing with, as one would think, every phase of engineering work, yet it is surprising how many subjects crop up in the course of the work on which very little information of workable value can be found. Many contractors criticize engineering books as containing too much theory which is no doubt a necessary constituent when used by students as a ground-work for the study of any engineering subject but on the other hand a busy contractor has seldom time to pore over a lengthy volume and pick out here and there the meat of the article in which he is interested. If he does not find what he is looking for almost immediately he goes back to the job and does the work his own way, with a deep-seated impression that if he had the information gained from some similar undertaking elsewhere, he might find that he was not doing the work in the most systematic manner.

Considerable time may be saved as well as much valuable information placed in an accessible location by carefully filing for future reference those engineering publications which contain matter of importance to the line of work in which the contractor is mostly concerned. By glancing over the publications weekly it absorbs but a few minutes to "spot" the interesting subject and place it aside in your files; thus a mass of material is accumulated at small expense, which may be bound together at the end of a year's time, and this material, together with the best text books and his own records of work performed, forms the foundation on which a contractor can build up a successful business. It has been said that an engineer who has left his books at home is in about the same position as a surgeon who goes to perform an operation without his instruments. This is no doubt partly true and in some measure applies to the contractor. Experience supplemented by the experience of others is, however, a splendid working asset.

Suspend Dust in the Atmosphere

IT has always been a popular notion that the impurity and objectionableness of an atmosphere was measured directly by the amount of carbon dioxide present. This idea is giving way, however, as the matter is being scientifically studied, and it is now claimed that the presence of dust takes decided precedence as an injurious factor. Indeed it is authoritatively stated that even where carbon dioxide is present in considerable quantity, its ill effects may be counteracted by keeping the atmosphere well mixed and constantly in motion—even without the introduction of fresh air. The evil effects of dust particles, however, end only with their removal.

The sources of the suspended matter in a rural district is mainly from the surface of the soil in the fields and from the roads The quantity suspended in the first instance is due to the nature of the soil and the climate, while in the second instance it is due largely to the grinding effect of vehicle wheels on the road surface, causing the pulverized material to be blown about by the wind.

In our cities, the source is somewhat different, especially where the streets are not oiled. The dust arises from the street sweepings containing all manner of foul material, but not only are the street sweepings the source of fine particles, but in the partial combustion of fuel in various industries, much fine material is carried up the tall chimneys and thrown into the air.

The determination of the amount of dust present thus becomes an interesting investigation. At a meeting of the Royal Meterological Society, the president, Dr. J. S. Givens, Assoc. M. Inst. C. E., gave some interesting figures of dust deposits in a number of cities. The deposits from the air for one year were measured, taking the interval from April to March, as follows:—

Manchester, 1915-16	835 tons per sq. mile
London, 1915-16	453 tons per sq. mile
Sheffield, 1914-15	395 tons per sq. mile
Malvern Wells, 1915-16 ...	56 tons per sq. mile

Dr. Givens claims that the really injurious material contained in the air is dust, and stated that the general reduction of atmospheric impurity during the winter of 1916-17 as compared with the preceding season was probably due to reduced consumption of raw coal.

War Time Lessons on Road Work

THERE is no doubt that roads in the War Zone have been under more severe tests than roads have ever been subjected to before. This is due not only to extremely heavy traffic at the maximum speed attainable because of congestion, but from shell fire, which no doubt produces unparalleled stresses on the road metal. If a road will stand up well under these severe tests, there is hardly any question that under ordinary after-war conditions the same construction will render the greatest length of service under the heaviest conditions of traffic. The following article by Walton Maughan, read before the Institution of Municipal Engineers, formulates a number of valuable lessons gained from the war in regard to road building:

(1) The advantages of straight and wide roadways with wide verges—in short, good road-planning with by-pass roads at places where there is undue congestion of traffic, narrow streets, etc.

(2) The soundness of Telford's theories and methods as distinct from some other eminent road makers of the past—in other words the importance of placing sound foundations—where possible Telford pitching—and providing for efficient drainage of both road-bed and surface crust.

(3) The unassailable superiority of well-made and preferably bituminous-bound macadam roads for country roads, and even for the heaviest of traffic, when as in this war we have so far improved our methods of distributing live loads and "cushioning" their effects.

(4) The outstanding importance of width in every road, inasmuch as width, and width alone, can give:—

(a) Free distribution of traffic over the whole surface, thus increasing far beyond the proportion of added width the life of the roadway—as the outsides soon get churned up under the strain of increasingly heavy traffic over underdrained and insufficiently metalled sides or channels which thereafter cease to drain the road.

(b) An immense saving of time to all traffic where a "three-way" road is provided even when a two-way road would, under perfect conditions, allow an almost-uninterrupted stream of traffic to pass each way. Similarly a "fourteen way" traffic width is, in heavy traffic, an immense time-saver as against a narrower roadway, even with such expert drivers as the war has produced—drivers the like of which there will never be on any ordinary roads.

(c) Width alone can give an adequate thickness of metal along the crown and haunches of a road—where if not strong enough the crust is soon loosened and crushed through the "spreading" sub-crust or weak foundation layer—without excessive cross-fall. Width again is necessary for drainage and to provide adequate abutments, and, in short, width is a sine qua non for that "generous" or "full" cross-section which is absolutely essential for the economical carrying of modern traffic.

(d) Every additional foot of width minimizes both the "transverse" wear caused by fast traffic "pulling out" to pass slower moving or when meeting all traffic, and also that longitudinal or central concentration of all traffic—but especially fast car and heavy commercial motor traffic—which results in "tracking" and the subsequent accelerated rate of wear owing to those destructive factors being made worse by weather influences and wet getting into the whole road-bed instead of being drained off it.

(5) The importance of levelled strips of turf adjoining the actual roadway and the absence of ditches and cross-grips or side drains and the great advantage of piped-in side drains, especially on narrow roads.

(6) Uniformity of standard of maintenance and of materials—e.g., no strips of bad pave, first on one side, then on the other, or down the centre only, or possibly across the entire roadway, and this too on roads of much less importance than others where quite important streets are made up with "very ordinary" macadam.

(7) The necessity of keeping trees well away from the roadway so that the branches overhang the footpath, but not the road. In the course of some hundreds of miles journeys, on even the most important of the routes nationales the overhanging branches and foliage were often such that only the centre of the roadway was available to motor lorries or 'buses, and the top seats of the latter had often to be entirely vacated. This inability to use the proper side of a roadway is almost equally noticeable in some of our own motor-'bus routes, and is a grave source of danger. Of course from a military point of view trees alongside roads are bad, except perhaps for preventing the enemy's observation of marching troops.

(8) The incalculable delay, expense and danger of bottle-neck lengths, narrow bridges or odd lengths of road, dangerous corners and cross roads, railway crossings, etc.

(9) The vital importance of providing footpaths, or even mere tracks, alongside rural roads—especially those subject to fast motor traffic—preferably well away from the road.

(10) The necessity for a constant and systematized study by road engineers of road traffic, and especially the effect of the various classes of traffic under various weather conditions upon the various road-surfacings and other materials used in the construction of roads with the co-operation of geologists and of chemists trained as practical specialists and concentrating their energies on road-making materials and methods only—in short, an authoritative body of experts whose services shall be freely available to every road surveyor or his council.

(11) The need for a similar study of traffic movements, of accidents and of enforceable safety precautions and road customs, the adoption of single large board direction posts, the abolition of speed limits as the "assessment basis" of the degree of danger, and the strengthening of the law with respect to real abuse of the road, such as driving to the danger of the public, etc.

(12) Last, but not least, the necessity for road-engineers to combine to protect not only their own interests and those of road authorities generally, but also with representative bodies of road users for non-party purposes for the benefit of the country whose industrial prosperity and success in the coming trade war will so largely depend on the efficient management of our roads—one of the greatest of our national assets.

Comparative figures issued by the city architect's department of Toronto demonstrate the great increase of building costs, even as compared with one year ago. In 1917, during the first four months, there were 211 brick houses erected at a cost of $271,650, while this year during the same period, there were 143 brick houses erected at a cost of $388,200.

Canada's Latest Power Development Scheme

Chippewa Creek Diversion to Queenston Heights Will Make Available a Head of 308 ft. New Canal Will Also Draw Niagara Water from Above the Falls — Ultimate Development 300,000 H. P.

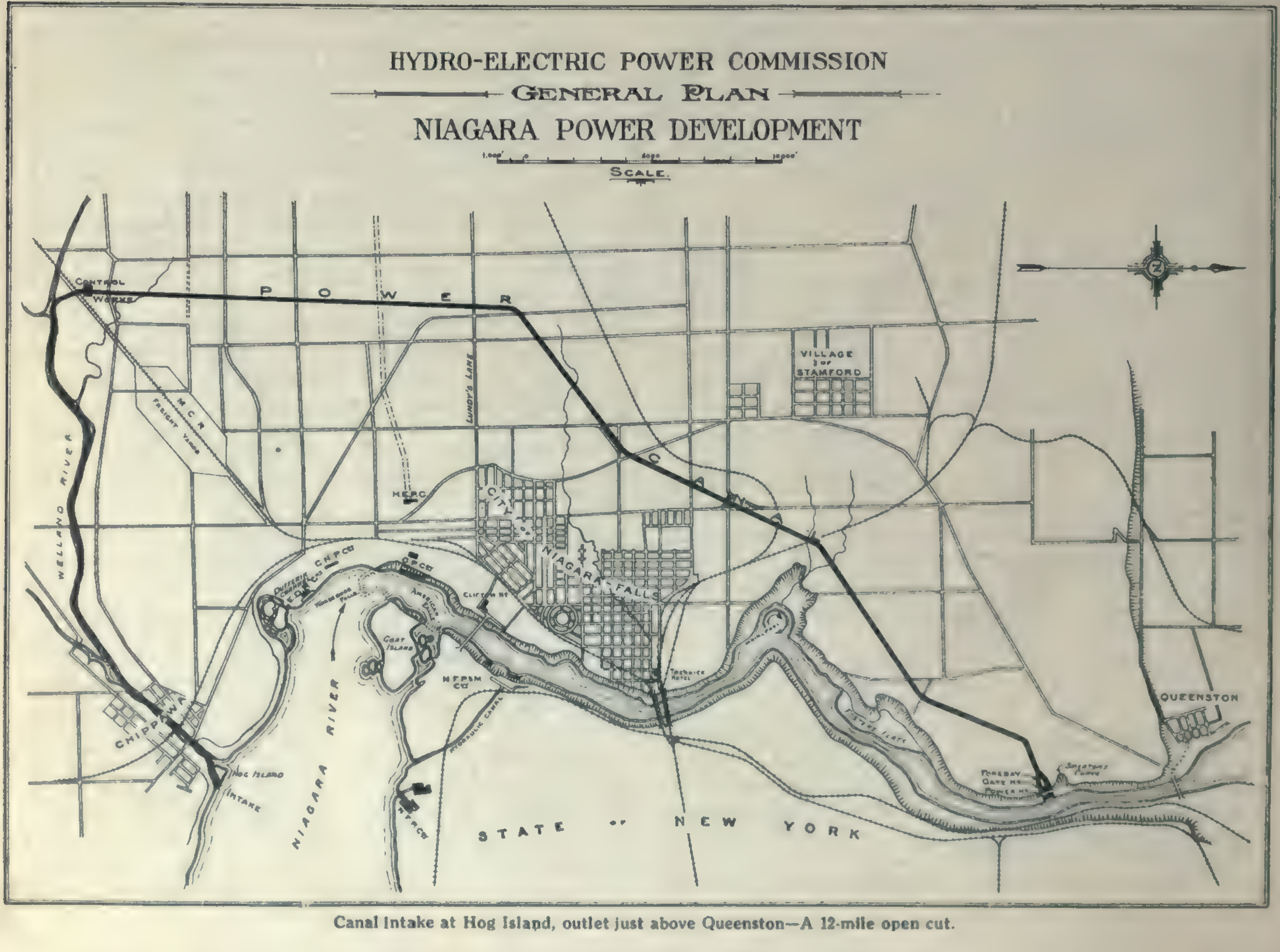
THE most interesting item in connection with the convention of Hydro Municipal Electrical Engineers, held in Niagara Falls, last Friday and Saturday, was the inspection of the work of development in connection with the new 300,000 h.p. plant of the Ontario Commission. The plans of the commission have now reached a stage when we are able to reproduce a lay-out of the whole scheme and also a cross-section of the development works at the power-house.

As will be seen from the drawing, the canal encircles the city of Niagara Falls, Ont., having its intake at Hog Island, Chippewa, and its outlet just above Queenston and in close proximity to the famous Brock monument. The total length of the canal is approximately twelve miles. After the most careful study of cost and efficiency figures, it was decided to make an open cut throughout, though for a section of the course where there is a heavy rock cut the advisability of tunnelling was carefully considered. It was shown, however, that the advantages were in favor of the canal even on this section.

The canal follows the course, for about the first four miles of the work, of the old Welland River, in which the direction of the stream has been reversed—that is, the Niagara River is tapped at Hog Island, the water being drawn west up the Welland River some four miles before it turns north into the canal. The grade of the canal throughout is such that the current will vary from one to four miles per hour, the velocity over the greater portion of the distance being around the latter figure. At this higher speed there is practically no danger of the formation of ice.

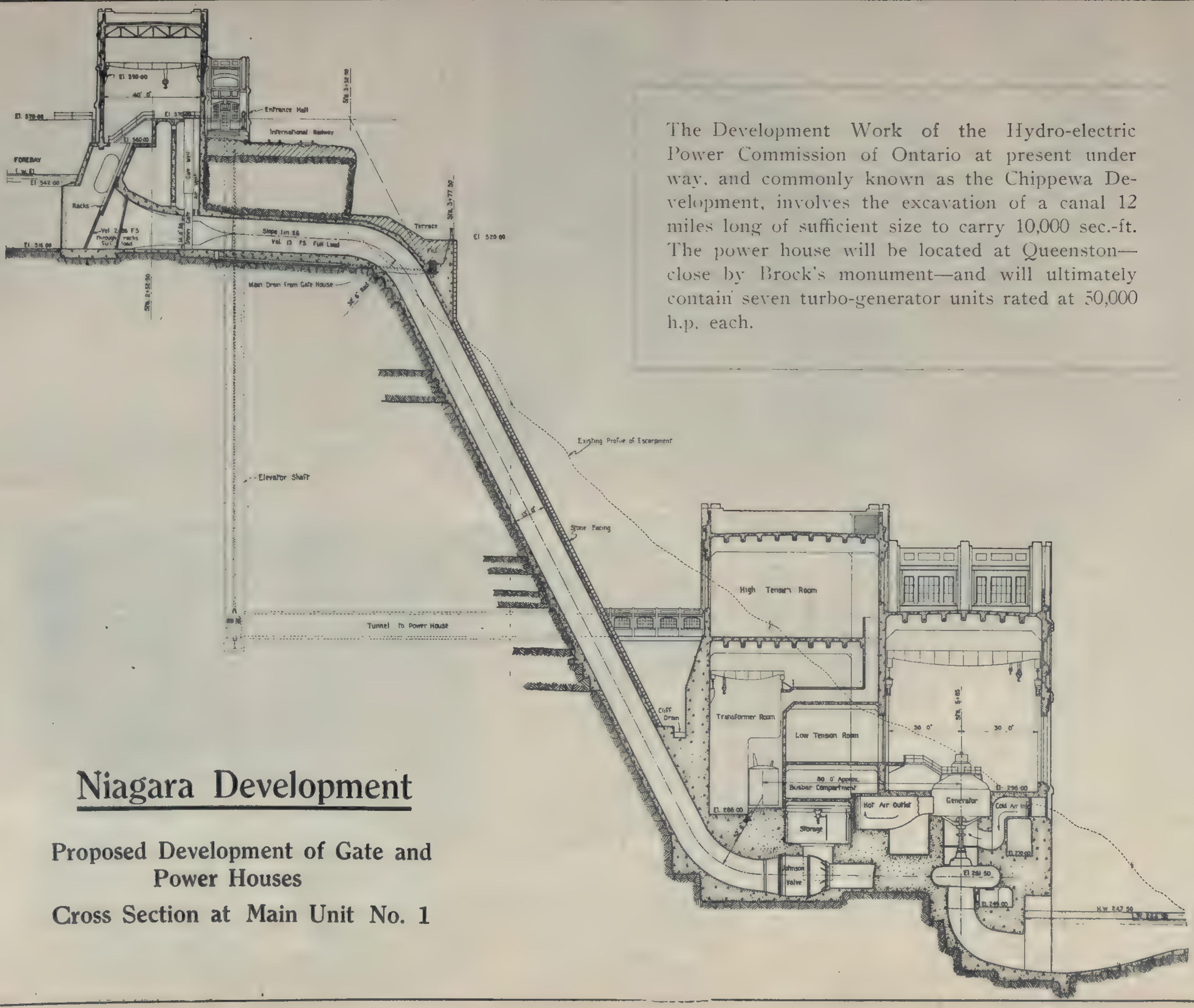
The work of excavation is going along as well as could possibly be expected under all the adverse conditions of the present day. A feature of the construction is the use of electric power down to practically the minutest detail. The engineers of the commission studied this question very carefully and were able to show a saving of almost 50 per cent. over other sources of power supply. One of the features of the excavation work is an 8-yard Bucyrus shovel, also electrically operated.

The canal and all the general works are planned for a development of 300,000 h.p., though it is probable that only 100,000 h.p. equipment will actually



Canal intake at Hog Island, outlet just above Queenston—A 12-mile open cut.

The Development Work of the Hydro-electric Power Commission of Ontario at present under way, and commonly known as the Chippewa Development, involves the excavation of a canal 12 miles long of sufficient size to carry 10,000 sec.-ft. The power house will be located at Queenston—close by Brock's monument—and will ultimately contain seven turbo-generator units rated at 50,000 h.p. each.



Niagara Development

Proposed Development of Gate and
Power Houses

Cross Section at Main Unit No. 1

be required at the start. A cross-section showing the general plan of the fore-bay, gate-house, generating, and transforming house, is also shown here. The total head obtainable according to this drawing is that approximately between elevation 554.0 and elevation 246.0, a difference of 308.0 ft.

The standard width of the canal will be 48 ft. and the penstocks connecting the head gates with the turbine room will be approximately 14 ft. in diameter. The turbines will be 50,000 h.p. capacity, so that the initial installation will call for two units. The ultimate installation will probably be seven such units—six for continuous operation and the seventh as spare.

The work of installation on the 50,000 h.p. addition to the Ontario Power Company's plant is also going forward, and it is expected this amount of power will be in readiness for the next winter's peak. When the larger development is completed, it is the understanding that the new additional installation at the O. P. Company's plant will be dismantled, this being considered an economical proposition on account of the much greater capacity obtainable from the same quantity of water owing to a practical doubling of the head.

Wall Construction by the Cement Gun

An interesting feature in connection with the Dominion Shipbuilding Company' plant is in the method of constructing the walls. The frame of the structure is of steel, while the wall openings are spanned by pre-cast beams reinforced with wire mesh. Steel window frames are used exclusively; the wall openings are being filled with the cement gun.

The form work for the openings, for use with the cement gun, consists simply of wooden panels set flush with the inner surface of the concrete beams. Outside of these is placed a sheeting of wire mesh, held in place at top and bottom by slots in the reinforced concrete beams and by small rods placed horizontally.

The concrete mixture is then applied to the mesh with the cement gun, filling up the space between it and the forms, effectually covering the mesh on the outside, and building up a reinforced wall some four inches in thickness. Finishers then trim off the irregularities and the final wall presents a good appearance, as shown by the cut.

The small number of men required to execute the work, as well as the speed attained speaks well for the efficiency of this type of construction.

Mistaken Statement Re Linseed Oil

Mr. Norman Holland, President of the Holland Varnish Co., Ltd., has drawn our attention to an error in our issue of April 24, in which we reported his paper on "Modern Varnish Making," read before the Canadian Society of Civil Engineers. The statement is to the effect that there was no such thing on the market as pure, raw, linseed oil.

Mr. Holland states that what actually happened was that at the conclusion of his paper a question was asked by a member present as to whether the ordinary boiled linseed oil on the market was pure or not. In answering this question, he said that the bulk of the ordinary boiled linseed oil was what is known as "bung-hole boiled"—that is to say, it is made simply by adding a liquid drier to the raw linseed oil, and is not made in the old way by heating the oil to a high temperature in contact with powdered drier. He also made the statement that paints were not made to-day with linseed oil only, as other oils were used. The wrong impression given in our report was due to a misunderstanding of Mr. Holland's statement. Mr. Holland advises us that his own company uses large quantities of pure raw linseed oil and that he has no hesitation in saying that every one of the linseed oil companies in Canada produces absolutely pure raw linseed oil. Mr. Holland asks that, in fairness to his company and to the linseed oil companies, this explanation should be given as much prominence as the original report received. We trust that this explanation will make the whole matter quite clear.

Steel Scaffolding Used for High Brick Walls

A method for building high brick walls by using standard lengths of scaffolding is described in "Contracting":

These trestles are made with light vertical steel angles fitted with diagonal braces and with top and bottom bent clamps adjustable by screws to engage light wooden horizontal pieces. After serving as caps for the lower story they also serve as sills to receive the lower ends of the next sections of trestles, and so on, enabling the trestles to be built up indefinitely to the required height with transverse steel braces and with longitudinal diagonal strips clamped on by adjustable devices engaging the verticals. In this case a two panel extension of the falsework was built at right angles to it providing a tower for a material hoist.

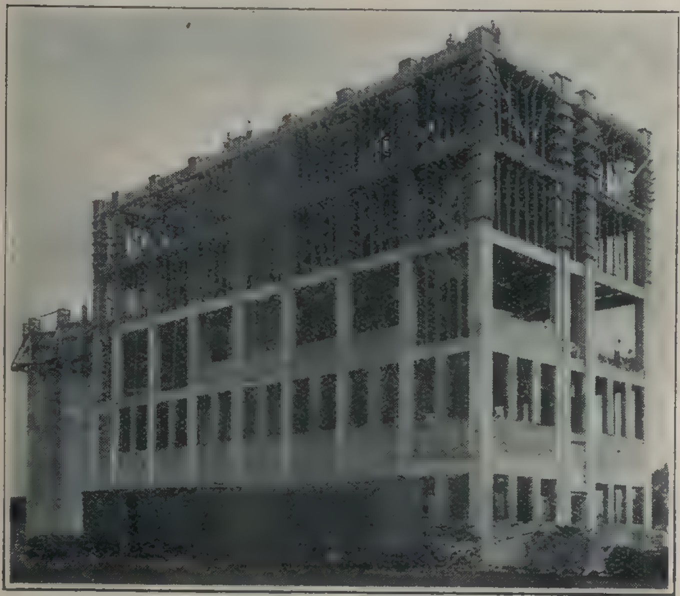
The trestles come in five standard lengths adjustable to any height from 16 in. to 8 ft. They are very quickly put together by common labor and are closely packed for storage or transportation, requiring much less space than wooden trestles.

The military authorities, having taken over St. Andrew's College, Toronto, for hospital purposes, want a better outlet to Yonge street than by the circuitous route along Roxboro road.

Construction of New Flour Mill at London

Hunt Brothers' Plant — Reinforced Concrete Beam and Column Design— Alternating Work Between Main Structure and Storage Tanks Avoids Delay

DURING the year 1917 an up-to-date flour mill was constructed for Hunt Bros., at London, Ont. The structure consists of a mill building of reinforced concrete beam and column construction of six stories and basement. The total height from underside of footings to top of coping on walls is 104 ft.; the size of each floor is 106 ft. long by 52 ft. wide. In addition to the main building, storage capacity for the wheat is provided by six circular, reinforced concrete tanks, 16 ft. in diameter by 75 ft. in height, each having a capacity of about 11,000 bushels. In order to provide the maximum storage capacity the interstices between the circular tanks, which are located in a group at the rear of the building were also utilized, giving the system a total storage capacity of 75,000 bushels. On top of the tanks a cupola was built to house in the conveyors and working space for the delivery of wheat into the bins.



As the early part of the spring of 1917 was wet, several serious delays were incurred in the progress of the excavation which was carried down some 12 ft. in a stiff clay, and which when wet became very slippery and difficult to work.

The general construction of the mill building is of reinforced column and beam design, the steel for same being supplied by the Trussed Concrete Steel Company. The wall spaces between the columns are built exclusively of brick; the windows are numerous and of the wooden sash type; the column and beam surfaces are left exposed.

The basement has a 6 in. concrete floor and contains the boiler room, fuel supply and car pit for the delivery of wheat into the mill. On the first floor are the hopper scales, two 100 and one 60 bushel scales. On the second floor are the storage bins and line shafting, while the conveying and mill machinery are on the other floors. Office accommodation is provided on the first floor by glass partitions in an easily accessible part of the building.

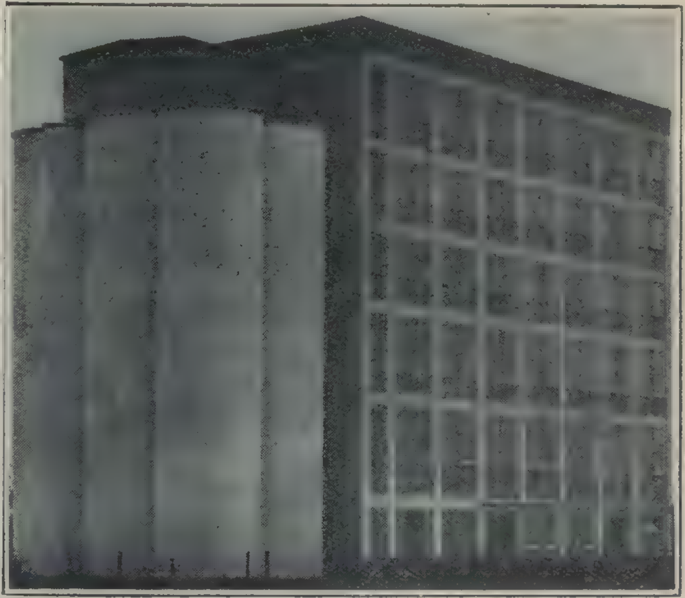
The floors throughout were carried out in mill construction using heavy supporting timbers carried on the concrete beams. Three-inch plank flooring was then laid and topped with a maple finishing floor.

The reinforced concrete storage bins were designed by the contractors, and in their construction the sliding form method was used. By suitably arranging the work the tanks were poured practically continuously. The concrete work was delayed by the wet weather until the middle of May when the work was carried out as follows.

The work was first started on the mill section so that generally the mill was one floor ahead of the tanks. The equipment consisted of a wooden hoisting tower which was built about the centre of one side of the mill building and the mixer was set up at the foot of the tower so that it delivered concrete into the tower hopper which was geared to a hoisting engine and elevated to the desired pouring level. All the concrete for both mill and tanks was therefore handled through this tower which was built up as the work progressed.

At the top of the tower the material was dumped from the tower hopper to another stationary hopper which was provided with a hand-operated valve. From this point the concrete was distributed to the different sections by using buggies running along temporary platforms.

When filling the tank forms the concrete was wheeled to a point on the mill floor adjacent to the tanks and let down a chute into another hopper which rested on a platform over the top of the tanks. From this platform ample space was afforded for handling the steel and pouring the concrete evenly all around the tank circumference.



In order to proportion the work and avoid delay, the sliding tank forms were filled; then, while the cement was setting and the forms were being lifted ready for another pouring, the concreting in the mill portion of the work was carried on.

The maximum depth of pour on the tanks was five feet, this being rather more than the depth of the tank forms. This was done by starting the pouring early in the morning, so that by the middle of the afternoon the concrete which was poured first, would be set hard enough to be self-supporting and the forms could be slightly raised. It should be remembered that this procedure was made possible by the hot weather, otherwise this speed could not have been attained. Notwithstanding the delay at the beginning of the work due to the weather, the whole of the concrete was poured by the first week in September.

In addition to the present storage capacity, a wood crib bin of a capacity of 20,000 gals. has since been constructed, thus raising the total storage to 95,000 bushels.

Transportation facilities are well provided for as the mill is supplied with sidings of both the Grand Trunk and Canadian Pacific Railways. In addition, the grounds have been laid out with a view to combining natural attractiveness with the necessary driveway accommodation for teaming purposes. In front of the mill and about 16 feet from the loading platform is a grass and flower plot 52 ft. x 40 ft., while the driveway from Nightingale Ave., is carried around the plot, giving ample room for the incoming and outgoing traffic.

Messrs. Watt & Blackwell, of London, were the architects, while the machinery for the mill was supplied by Canadian Allis-Chalmers. The contractors were Archibald & Holmes, Toronto.

Organization for Sewer Construction Work

Methods Adopted in Chicago—Thorough Systematizing Produces Very Efficient Results—Co-ordinating Work of Men and Machinery

DIFFERENT methods of sewer construction are continually being presented, which offer increased facilities for the handling of material and reducing the number of workmen required. Owing to the wide variance in the conditions under which the work is carried out and the large number of different types and sizes of sewers, each having its special adaptation for certain grades conditions of flow and ease of construction in certain kinds of underground formations, it is evident that the work for each type should be carefully classified as to the proper organization of forces, class of machinery best suited to the work, and the most efficient means of lowering construction costs. Mr. H. E. Hudson, Division Engineer of the Board of Local Improvements, Chicago, discusses in the following article in Municpial Engineering the methods used in sewer construction in that city:

In Chicago, there has been a natural division of sewer work into classes. The first class of construction, we may say, is the sewer work constructed in machine excavation. This class further subdivides itself into the small and large sewers.

The design of excavating machinery and the development of its use in field construction has drawn a natural line of division between the large and small sewers somewhere between 3 ft. and 4 ft. in diameter. Sewers ranging in size from 3 ft. down are classed as small sewers, and those ranging from 4 ft. up are classed as large sewers.

Small Sewers.

Machines which handle the small sizes of sewers are usually developed for speed of travel for the narrower trenches, and their efficiency has been worked out on this class of work. Actual yardage of excavated material is large, but it is excavated in small units and at a great speed. These machines are often equipped with changeable speeds and various sized buckets or other arrangement for trench width such as will enable them to dig trenches for sewers larger than those indicated in the general classification as small. For instance, there are three types of machines of the endless belt type, capable of excavating for small pipe sewers at great speed that can be geared down and made to dig trenches for sewers up to 5 ft. in diameter. The contractors in general, however, seem to draw the dividing line about where it has been indicated, and show considerable hesitation in over-stepping the limits indicated. Other contractors have tried the use of larger machines capable of excavating for the larger size sewers equipped with special fittings for digging small pipe sewers. The loss in efficiency has been much more apparent in these cases. While it may be possible to equip the machines used on some of the larger sizes, the reverse condition is not so true, and usually little economy has been accomplished in the use of heavy machinery for lighter work.

Hand Excavation and Miscellaneous Class.

In addition to the work constructed in machine excavation there are two other classes of work, namely, those constructed in hand excavation and a miscellaneous class. Hand excavation on certain classes of work may be due to special conditions, such as rock, running sand, etc. The third class, called "miscellaneous," includes such work as digging up and rebuilding existing sewers, or the construction of new relief sewers in closely built-up communities. This last class usually requires special machinery for excavation, or possibly hand excavation under particularly difficult conditions.

Development of Excavating Machinery.

Going back to the classifications of work done in machine excavation, we find that the greatest progress has been made in the development of machinery for this kind of work on the so-called smaller sizes. During the last ten years approximately six different types of machines with which the writer has been familiar have been developed and tried out in the Chicago field. Two of these machines have survived as being the most efficient and satisfactory for this work. Each of these machines has gone through a process of evolution so that one would scarcely recognize the present type of machine as a development from its original form. Some parts have been made stronger, some of the methods of handling excavated material have been changed, and the tendency on the whole has been toward a more rapid excavation. This tendency toward speed in excavation has necessitated the contractors increasing the efficiency of the organization which is to follow behind the excavating machine.

Organization of Forces.

The organization of the field force surrounding one of these machines may be divided into three separate groups: the excavating organization, the constructing organization, and the backfilling organization.

The constructing organization may be further subdivided into that which constructs the sewer proper and that which constructs the various structures connected with the sewer, such as manholes and catchbasins.

Excavating Organization.

In the excavating organization, if the outfit is operated by steam, we find an operator and fireman on the machine. There is another man carrying coal and levelling the ground ahead of the machine. Immediately behind the machine there are two men engaged in handing down sheeting and steadying it until one of the bottom men has placed the cross bars between the upright sheeting. Following the excavating machine in the bottom of the trench there are usually two men; one man engaged in throwing the loose excavated material ahead to the buckets as they pass around and placing sheeting and braces, and the other man engaged in trimming up and smoothing the bottom of the trench so that the pipe laying may follow rapidly. This gives a total of seven men in this group.

Constructing Organization.

Following this group comes the constructing organization laying the sewer proper. Here we have one man in the bottom laying the pipe, and under Chicago conditions we have a bricklayer sealing off the pipe and junctions as rapidly as they are laid. On the surface of the ground there is one man passing pipe down to the pipelayer and one man engaged in carrying pipe from the side of the street to the trench. In this portion of the constructing crew there are four men.

In addition to this construction group there is a force engaged in building manholes and catchbasins. This force usually consists of one bricklayer, one bricklayer's tender, one brick tosser, one brick carrier, one cement carrier, and perhaps an odd laborer. In this group then there are six men.

As an added number to these two constructing groups there will be the cement mixer and another odd laborer, all under the supervision of a competent foreman.

Scheme for Relieving Tired Men.

When ground conditions are favorable and the average excavation does not exceed 8 ft. or 9 feet. deep, these excavating machines are capable of digging from 1,200 to 1,600 ft. of trench in a working day of eight hours.

The handling of the material for the construction of this kind of sewer becomes a very great problem, and it is frequently necessary to make changes in the men so that the burden of the hard and fast labor will not fall too long upon the shoulders of any one or two men. When the contractor has reason to expect that he is going to make this rapid progress, or when the size of the sewer becomes 20 in. in diameter or greater, he usually supplies from 3 to 6 additional laborers who are kept busy at odd work around the machine and are kept as alternatives for replacing the men in the regular organization when they become tired.

Backfilling Organization.

The backfilling on such a job is usually done by a type of backfilling machine, several of which have been developed to meet the demand created by the perfecting of the excavating machinery. One of the most popular among the gasoline driven machines is the Parson's trench filler. This machine requires one man to operate the machine and one man to guide and steady the bucket or bucket board. Several attempts have been made to do away with the man guiding the bucket or bucket board, but up to the present time no type of machine has been developed which completely eliminates this man. This is particularly true of the lighter machines used for this work. There have been one of two heavier machines developed carrying a heavier bucket board, which apparently needed only occasional steadying by hand, but these machines have been so much heavier and more cumbersome that the rate of progress they have shown has not compared favorably with the lighter machines requiring the additional man. These machines have not been capable of backfilling each day all of the trench excavated by the excavating machine, but, as there are usually delays of one kind or another arising on this kind of work, the machines are on the whole able to maintain an average rate of backfilling about equivalent to the average rate of excavation.

Including the night watchman, the total organization for such work will usually number 22 to 28 men. The actual number employed may be as low as 22 when skilled and well-trained men are employed. There

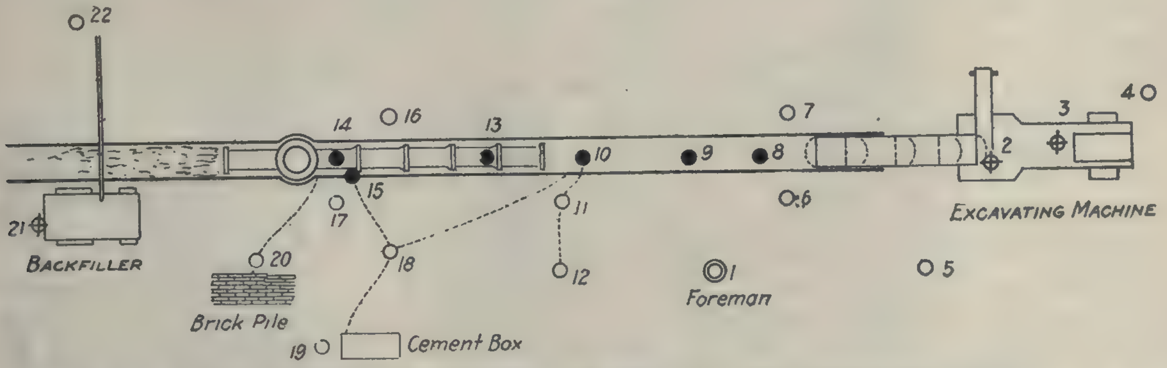


Fig. 1—Chicago organization for constructing small sewers with power excavators and backfillers

1, Foreman. Excavating Organization: 2, Operator; 3, Fireman; 4, Laborer; 5, Coal Passer; 6 and 7, Bracing Tenders; 8, Bottom Bracer; 9, Bottom Man. Constructing Organization: 10, grader; 11, Lowering Pipe; 12, Pipe Passer; 13 and 14, Brick Layers; 15, Brick Layer's Tender; 16, Laborer; 17, Brick Tosser; 18, Cement Carrier; 19, Cement Mixer; 20, Brick Wheeler. Backfilling Organization: 21, Backfiller Operator; 22, Laborer.

are usually some new men in the group and this will necessitate additional men up to the number indicated.

Standard Reduced Form of Organization.

The general organization indicated for the smaller sewers is that which would be used by a contractor equipped with a machine capable of performing the amount of work indicated for the 8-hour day. There are several contractors in Chicago equipped with excavating machines for this class of work, whose machines are not capable of the rate of excavation indicated in the foregoing organization. In order to balance their efficiency and costs so that they may compete with the others, it becomes necessary for them to eliminate some of the workmen.

A gasoline driven machine eliminates the firemen. It also eliminates the necessity of carrying coal or maintaining a water line. The extra duties of this coal passer are usually performed by the man handling sheeting or by the odd laborers. As the speed is not so great, there is only one man in the bottom behind the machine who does all the bracing and trimming. The organization used for digging is therefore reduced to four men instead of seven.

The constructing organization is about the same as that indicated in the former organization, except that there is an opportunity to do away with the men carrying pipe from the side of the street. If the material is properly distributed along the line of the work, there is also an opportunity to do away with the man who carries brick. Such an organization is indicated, and carries a total of 14 workmen under the direction of one foreman.

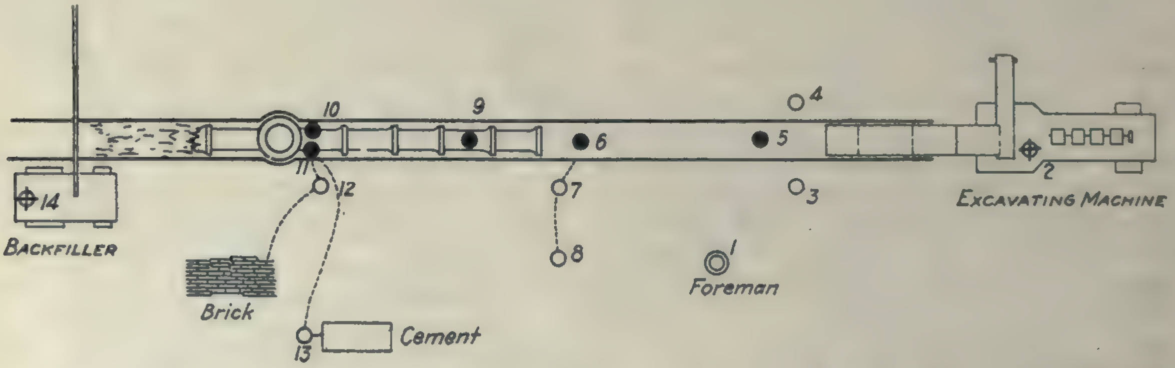


Fig. 2—Chicago Organization for constructing short lengths of small sewers with gasoline ditcher and backfiller

1. Foreman. Excavating Organization: 2, Operator; 3 and 4, Bracing Tender; 5, Bracer and Bottom Man; Constructing Organization: 6, Grader; 7, Lowering Pipe; 8, Pipe Passer; 9 and 10, Brick Layers; 11, Brick Layer's Tender; 12, Brick Tosser and Carrier; 13, Cement Mixer and Carrier. Backfilling Organization: 14, Backfiller Operator; 15, Laborer.

Such an organization is used for the construction of small lengths of work, and it is very often possible for the contractor to do away with one bricklayer in such an organization, allowing the pipe to be laid and sealed by the bricklayer, and then during the occasional delays having the bricklayer go back and construct necessary manholes, allowing the catchbasins to be left until the sewer proper has been constructed. He can then so arrange his organization that a portion of the workmen are excavating for catchbasins while the bricklayer is building them.

The outfit for backfilling is the same as that indicated for the other organization.

It must be understood that these organizations are set up as types of standard organization such as might be used for certain classes of work, and that various contractors interchange or rearrange the labor to suit special conditions on their work. Variations in soil character, depth of excavation, size of sewers and many other conditions will enter to change this standard organization..

Keeping Close to the Machine.

It is an unwritten rule on this class of work that the laying of the sewer and the construction of manholes on the sewer should follow as closely behind the excavating machine as possible. The efficiency of this method is apparent. It is not then necessary to sheet or brace the walls of the trench as thoroughly as where other procedure is followed. The machine automatically sets the pace for the workmen to follow and this has a tendency to increase the speed of the workmen. The contractor is also enabled to keep his organization together and under his eye. One of the greatest economies which the contractor can accomplish is found in the utilizing of the odd laborers or spare workmen on such work. When these men are not actually performing some duty in connection with the excavation for or construction of the sewer, they can be used in backfilling over the pipe, digging out braces and sheeting and carrying them ahead, moving cement boxes, and the multitude of small duties that are found in attending such construction work.

Keeping Expensive Men Busy.

The balancing of the work so that the higher priced men, such as bricklayers, machine men, etc., are not allowed to stand idle is one of the great problems of this class of work. The preparation of the excavation for the construction of manholes and catchbasins for the bricklayers and the steady repair or moving of the machine will tax the contractor's ingenuity to the utmost. Most of the work done by the contractors in Chicago, who have followed this construction for a number of years, is as carefully planned and timed as one could imagine.

Use of Steam Shovels.

In regard to the larger sewers constructed in machine excavation there has been little change in the general type of machine used for this work. About 1893 a Chicago contractor conceived the idea of mounting a steam shovel on stringers across the trench and excavating for the larger sizes of sewers with this machine. This practice has been developed somewhat, and the efficiency of the organization constructing the work in this kind of excavation has been greatly improved, and, while the general arrangement is the same, the cost figures and the rate of progress show that the Chicago contractors regard it as an efficient and economical method of constructing sewers.

Manufacturers of steam shovels have constructed special booms and dipper sticks for deeper excavations and have equipped these steam shovels with larger drums and more powerful engines, showing that they have recognized this field of work.

Organization for Construction of Large Sewers.

The organization of the force for the construction of a large sewer varies greatly with the size of the sewer and the depth and character of the excavation. In a manner similar to that outlined in the small sewer work, this orgonization may be divided into three groups; the excavating, the constructing, and the backfilling organizations.

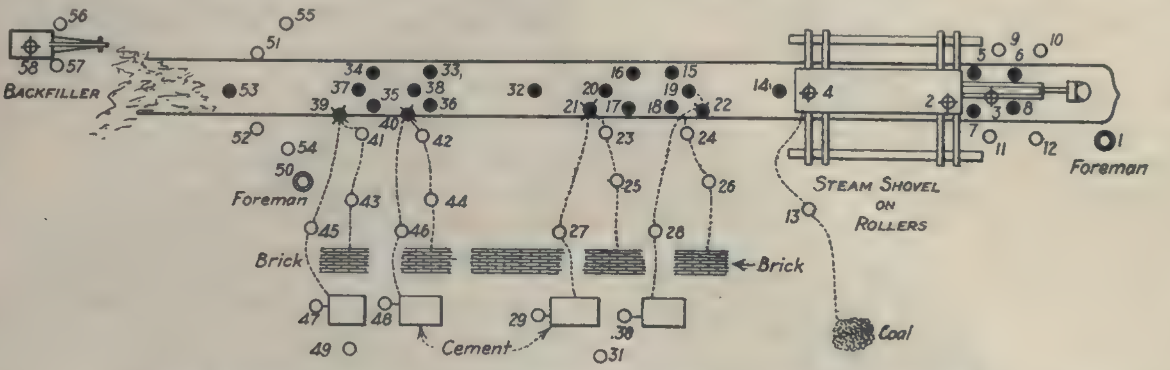


Fig. 3—Chicago Organization for constructing large sewers with use of heavy machinery

1. Foreman. On Machine: 2, Engineer, 3, Craneman; 4, Fireman. Excavating Organization: 5, 6, 7 and 8, Bottom Trimmers and Bracers; 9, 10, 11 and 12, Sheeting Passer and Roller Tender; 13, Coal Passer; 14, Bottom Trimmer. Bottom or Invert Organization: 15, 16, 17 and 18, Brick Layers; 19 and 20, Brick Layers' Tenders; 21 and 22, Scaffold Men; 23 and 24, Brick Tossers; 25 and 26, Brick Wheelers; 27 and 28, Cement Carriers; 29 and 30, Cement Mixers; 31, Laborer; 32, Form or "Center" Setter. Arch Organization: 33, 34, 35 and 36, Brick Layers; 37 and 38, Brick Layers' Tenders; 39 and 40, Scaffold Men; 41 and 42 Brick Tossers; 43 and 44, Brick Wheelers; 45 and 46, Cement Carriers; 47 and 48, Cement Mixers; 49, Laborer; 50, Foreman in Charge of Constructing Organization; 51, 52 and 53, Laborers Pulling Sheeting; 54 and 55, Laborers Carrying Sheeting. Backfilling Organization: 56 and 57, Laborers; 58, Operator on Backfilling Machine.

Type of Organization on Large Sewers.

As a type of organization, let us take the force used to construct a 5-ft. circular brick sewer in an average cut of 15 ft. See Fig. 3. The excavating force on such a job consists of the engineer, fireman and craneman on the steam shovel; one man is also engaged in carrying coal to the shovel. Working immediately around the shovel there are two men engaged in carrying planks and rollers ahead to provide the runway for the machine. In addition, there are two men engaged in carrying up sheeting and bracing from the rear of the trench and placing it so that it may be easily reached when it is necessary to sheet a new section of the trench. Working directly below the shovel in the bottom of the cut there are four men; two of these men are usually engaged in trimming and shaping the bottom preparatory to laying the brick work, and the other two are usually engaged in running forward between each cut of the dipper and trimming the banks so that the sheeting will assume a straight line.

When the signal is given to the engineer that the excavation has proceeded to a proper point the four men in the bottom carry forward a temporary scaffold and quickly place it across the trench. This usually consists of two or three pieces of 2-in. pipe cut so that they just span the width of trench. Upon these are placed 2-in. planks so that when the men stand upon these planks they can reach the level of the stringers supporting the sheeting. The four men on top then pass down the stringers and sheeting for the new section of trench to these men on the scaffold.

After the stringer has been placed and the sheeting dropped in behind, the men on the top usually cut down a little fine material so that when the brace is tightened there is a firm and even bed between the sheeting and the wall of the trench. The signal is then given for the move ahead, and the four men on the surface "stand by" to watch the rollers as the machine is pulled ahead. While this is being done the four men in the bottom are usually engaged in putting in permanent braces and stringers for the section which has just been "sheeted".

The progress of the steam shovel, aside from the ability of its operator, is almost entirely dependent upon the rapidity with which this organization carries out its work.

Rates of Progress.

There have been several instances under the observation of the writer where the sheeting and bracing of a section of trench and the move ahead have been completed in from 4 to 9 minutes on the type of work indicated. The writer has also been familiar with several organizations where this same work took from 15 to 25 minutes.

In addition to the two men indicated as trimming the bottom of the trench, most contractors have found that it was to their advantage to have an additional man in the bottom setting the form for the brick work and finally shaping the trench. Nearly all contractors have found that it also pays to have a foreman whose duties are entirely concerned with the operation of this excavating crew. It is his duty to see that the steam shovel is properly lined up, that the sheeting and bracing is done properly, and that the efficiency of the whole organization is at its top notch.

Such an organization will dig from 160 to 200 ft. of trench in good clay soil in a working day of 8 hours.

If the construction organization is such as will keep pace with this orgonization, these rates can be maintained. Usually, however, it is found that the rates of speed on the average are not such as to justify an organization capable of constructing 200 ft. of this class of work.

The writer is familiar with a number of pieces of construction of this class, where the constructing organization was limited to 160 ft. to 180 ft. per day, and the excavating organization were allowed to go home after completing a sufficient amount of trench. These men realizing that they were working for their own personal gain, therefore developed a great efficiency and were known to go home at 2 and 3 o'clock in the afternoon after completing a sufficient amount of work for that day.

The construction organization which follows behind this excavation is developed into two parts, but quite differently from the division on the small work. It is customary on this work to organize the forces into what are known as "bottom" or "invert" and "arch" crews. The "invert" gang constructs the lower half of the sewer from the flow line to the spring line. It is then necessary for the contractor to set up a temporary centre for the support of the "green" brick work and the arch, and on this the "arch" gang constructs the upper half of the swer.

Invert and Arch Gangs.

The constructing organization for the "invert" of a sewer of the size indicated would consist of four bricklayers with two bricklayer tenders, two scaffold men, and two brick tossers. Carrying or wheeling brick to these tossers are two brick wheelers,, and carrying cement are two cement carriers. It has been found very advantageous on this class of work to set up guard stakes and sheeting along the side of the trench against which the brick can be piled in quantity sufficient for the masonry work so that all of the brick will be within easy reach of the brick tosser and no delay result in his reaching for material. It has also been found that a long plank thrown across the trench will enable the cement carrier to hand his cement directly to the scaffold men and thereby occasion little delay in stopping the brick tossers. These cement carriers watch their opportunity and when the brick tossers and scaffold men stop for a moment, as they usually do on this work, the cement is passed down quickly to the tenders in the bottom and the tossing of brick resumed with almost no delay. It has also been found that two cement mixers are needed for this work; one mixer is usually preparing sand and cement and getting the next batch of cement ready while the other is engaged in tempering and turning over the mortar which is being used. By the time his box is empty the other is ready for use. These men are usually assisted by one laborer. As soon as the invert is completed the joints are "struck" and the organization moves ahead into the next "bottom."

Between the "bottom" gang and the "arch" comes the "centre setter." It is his duty to "strike" or take down the centres after the work is set, carry them forward and set them up ready for the new work. This work usually requires a major portion of his time, but when a man becomes skilled at the work he has considerable time during which he is usually engaged in "cleaning down" the arch or wheeling ahead the surplus cement from the completed work. On these forms the "arch" gang constructs the brick work in two sections. Usually there are four bricklayers in such a crew working in pairs. The two leading bricklayers construct the wall from the spring line up, turning the so-called "quarter," while the two followers close or "key up" the arch.

Maintaining Progress Balance Between Invert and Arch Gangs.

The organization for cement and brick is practically identical with that of the "bottom" crew. When it is necessary to construct a manhole on the sewer, one bricklayer is usually detailed for this work. This necessitates a slight rearrangement of the gang and usually slows up the arching process, and it frequently becomes necessary to bring back the bricklayers from the bottom and turn a sufficient amount of arch so that it may be kept fairly close behind the invert construction. Any such rearrangement of crew results in confusion, and the contractors are more apt to put on extra bricklayers in either "bottom" or "arch" gang so that proper balance may be maintained. The difficulty in employing an extra bricklayer comes from the fact that it usually necessitates the employment of an extra tender. These tenders are capable of handling material for two bricklayers, and the contractors are more apt to employ two bricklayers at a time and endeavor to balance the rate of construction by sending them from the bottom back to the arch and vice versa. Such an extra crew understands its duties and performs them wth less confusion than that occasioned by the transfer of the whole "bottom" or "arch" gang.

In charge of this constructing organization there is usually a foreman whose sole duty is to see that the materials are kept moving properly and regularly to the workmen, and that the proper balance in rates of construction is maintained between the arch and the invert. Following this constructing crew there are usually three or four men taking out braces and removing sheeting from the trench. Supplementing this work there are two men engaged in carrying this material ahead to the new excavation. Where the shovel is maintaining a fair rate of excavation, the travel of these men from the rear to the shovel may be as much as 200 or 300 ft. As the sheeting and braces are easily taken out, the men engaged in their removal usually have sufficient time to cut down the sides of the bank and backfiill around the sides or quarters of the sewer before the centres are struck.

Backfilling with Orange Peel Bucket and Locomotive Crane.

Following this organization comes the backfilling. On the class of work indicated several types of backfillers have been developed. The range of experiments for this purpose seem to have covered the whole field. Almost every imaginable type of machine has been tried out—drag line buckets, orange peel buckets, clam shell buckets and many special types of buckets have been tried. In general, the Chicago contractors have conceded that the best type of machine for this class of work is the orange peel bucket carried by a locomotive crane. This machine is self-propelling, has a wide range of operation, and is capable of cleaning up the work in very good shape, and is usually operated by one man. It has been found that two laborers accompanying such a machine are usually sufficient. These men adjust the track or run-way for the machine and maintain the water connections. Such an organization as that indicated is example for maintaining the rate of speed indicated under the excavating.

The employment of unskilled labor in this class of work has usually been disastrous and the time and labor spent in training them is usually far more costly than the higher wage paid to the skilled workmen.

As in the case of the smaller sewers, the opportunities for economy are many. Delays in machine excavation due to breakdown of machinery or bad or caving ground under the shovel often require the contractor to readjust his organization entirely and even under the best conditions the contractor must be constantly on the alert. One of the frequent sources of delay is lack of sheeting. If the ground becomes very good the contractor is tempted to speed up the excavating, and soon finds himself with all his sheeting in place and nothing left for the new excavation. Oftentimes the excavated trench will cave under the sheeting and require excavation by hand on scaffold. This introduces great delay.

Estimating Methods for the Contractor

A Vital Factor in the Business—Accurate Records Necessary—Some Examples of Typical Practice

THE ordinary business man, in order to keep tab on his profit and loss account, uses strictly business accounting methods. Is not the contractor under the same responsibility when it comes to a question of prosperity or bankruptcy, as the merchant? In fact, the merchant is not dealing with the element of uncertainty to anything like the same degree as the contractor. The great disparity in bids for the same piece of work, which is so very general, has resulted in creating considerable doubt in the minds of the people as to whether contractors as a whole use reliable business methods. The following article by Mr. E. L. Seabrook, in the National Builder, throws considerable light on the subject of estimating methods and its importance as the fundamental item of all contract work:

Estimating is the vital part of the contracting business. The estimate can put the business into bankruptcy or place it in a flourishing condition. Correct estimating depends upon a great many factors, and the estimator must know a great deal about many things. Business methods are focused in the estimate; handling labor and right buying of material are also component parts of it. The estimator in large and complicated construction work holds the financial future of his firm at the point of the lead pencil. This is no less true of the small building contractor.

Despite the vital importance of estimating, many go at it in a most haphazard manner rather than as a serious business problem involving profit or loss and the financial stability of the business.

Accurate estimating is possible only by comparing the quantities of labor and material actually used with the amounts estimated. In order to do this it is necessary to keep in some permanent form a record of the quantities used in compiling the estimate. Some element of uncertainty enters into estimating, but there should be no "guess work" permitted on such a vital business problem. Estimating should be based on experiences from contracts and work already performed. This experience will be available if proper accounting methods are practiced. This involves the keeping of an accurate record of each piece of work, big or little, of the amount of labor and material used. How is it possible to intelligently make an estimate or price when it is not known whether the exact kind or similar work previously performed yielded a profit or made a loss?

In spite of this self-evident fact, many go on making estimates without the slightest idea as to whether previous work of a like nature was done at a profit or a loss. From this it will be seen that estimating is closely allied to accounting and bookkeeping. The competent estimator must draw his data from several sources; prices of material, labor, experience on similar work, and a bookkeeping or accounting system which will show, among other things, the cost of conducting business or overhead.

Every estimate or price is or should be composed of four elements: Labor, Material, Overhead, Profit. Even a casual study of the composition of an estimate or price shows that it is not correct if it does not contain these four elements. It is, therefore, quite apparent that the proper method is to build up the estimate or put it together from the elements that compose it. While these four elements are related to each other, each is distinct so far as the quantity or amount is concerned. When the estimate is completed it should be possible to know the exact amount allowed for each element. When the contract has been completed the estimated amounts should be compared with those actually used in the performance of the work.

The Building Contractors Methods as Compared With Those of the Merchant.

The building contractor is no less a merchant, because he applies the material he buys to buildings, than one retailing merchandise. But he has assumed two jobs instead of one. The compilation of a price, and distribution of the operating expense, differs radically between merchandising and contracting.

In merchandising the selling price is placed on the article after its cost is known.

In contracting the selling price is placed on the work before the cost is known.

The merchant takes his cost from the invoice; the contractor must estimate the amount of labor and material required, and is never certain of the cost until the work is completed. The merchant in naming his selling price has no fluctuating factors, such as labor and material. There being but one method of applying "overhead" and profit, price uniformity of merchandising naturally follows. Evenness and stability of prices are the results of such uniform application in merchandising.

Unfortunately this uniformity of cost of overhead and profit application does not exist in contracting. The contractor must estimate, and there is an element of uncertainty; and because of this uncertainty many contractors take a gamble. If, like the merchant they knew exactly where cost ended, there would be no disposition to take a chance. Then again; there is no such thing as a perfect cost system. The exact cost of an article, where more than one line is taken on, is not determinable. For all practical purposes, however, the approximate cost, or overhead, can be determined. Different methods of distributing expense, or overhead, produce different estimates or prices. The cost of conducting business is of necessity distributed on a theory, and these theories are legion. A dozen firms will have as many expense distribution theories. None of these is perfect, otherwise it would be a fact and not a theory. Ten firms, with as many theories of expense distribution, will make ten different selling prices. The overhead enters largely into the contracting business, and the distribution of this expense is the reason for variation in estimates from the same plans and specifications. The percentage of overhead may be the same, but the method or theory of distributing this produces different results in the final estimate. This variation can be very forcibly illustrated by the experience of two firms in the same line of business, located in adjoining towns. The sales of both were nearly the same and both made a fair profit. One firm based its overhead on productive labor, which was 51 per cent of this item; the other took productive labor and material combined, amounting to 22 per cent., as the basis upon which to apply the overhead. The accounting systems of both firms were excellent, and there is nothing exceptional in the ratios of expense.

Suppose these two firms are invited to estimate on the same contract, using these ratios in computing the overhead in the estimate.

Estimate No. 1

Cost of Material	$200.00
Cost of Labor	340.00
	$540.00
Overhead, 51% Productive Labor	173.40
First cost	$713.40

Estimate No. 2.

Cost of Material	$200.00
Cost of Labour	340.00
	$540.00
Overhead, 22% of Labor and Material	118.80
First cost	$658.80

It will be seen that there is a difference of $54.60 on the item of expense alone between the two estimates when first cost is reached, which will be increased, if profit is added on a percentage basis. All good estimators will admit that this variation between the two estimates is entirely too great for so small a total amount. It is self-evident that this variation is due entirely to a lack of uniformity in applying the overhead. If the quantities are reversed—Productive labor, $200; material, $340; using the same expense ratios—there is still a difference of $16.80. While this sum is not large in comparison with the total amount of the estimate, it is based solely on one item, and from that standpoint the variation is too large.

Let us look at this difference of $54.60 from another angle: Suppose two men varied in their estimates of $54.60 on the correct amount of material, $200. It is quite evident that some one would be wrong. Is there any more reason why two firms should be $54.60 apart on the "overhead" item of the estimate than they should be on material? If it is essential to have uniform plans and specifications upon which to estimate, is it not also reasonable that there should be some uniformity in estimating methods? This does not mean that every firm should have the same book-keeping system, but that they should approach the cost of doing business and the application of it on the same basis, or by the same method. General contractors often express surprise at the great variation in the bids of subcontractors. While much of this may be due to loose methods, guess work and mistakes, undoubtedly a large portion is due to a lack of uniformity in applying the overhead.

Forms of Estimating.

The forms and practices of estimating and price-making almost defy enumeration and description. These vary from the clumsy, careless, unreliable, all the way up to methods that are as near perfection as possible. These forms and practices all fall under three general systems: Rule of Thumb, Lump Sum, Unit of Labor and Material. The first step is taking the quantities from the plans, etc. The care with which this should be done is too self-evident to need any comment. A permanent record in some form should be made of the estimate; this should be in a book or on make-up sheets. Provision should be made for a comparison when the contract is completed. Estimates should not be made on scraps of paper. If the estimate is too trivial to be well done, it had better be left alone.

A few estimating examples drawn from actual business practice will illustrate the proper and improper methods of compiling prices. Although the amounts in these examples may seem small, the principles and methods of correct estimating are the same regardless of the amount, and it is these upon which the attention is directed. As illustrated above, every profitable estimate or price will be composed of these four essentials.

Cost of Material	$......
Cost of Labor	$......
Expense, Conducting Business	$......
Cost, or safety point	$......
Profit	$......
Price, or Estimate	$........

The work upon which the following estimate was made was performed on a building in Pennsylvania. The first column is the estimate in condensed form; the second column shows the contract cost:

	Estimate	Cost
Materials (itemized)	$1,119.00	$1,094.24
Labor (productive)	380.00	333.00
Expense, 55% Productive Labor	209.00	183.15
	$1,708.00	$1,610.39
Profit, 30%	512.00	
Bid	$2,220.00	
Profit		$ 609.61
Contract Price		$2,220.00

The completed work shows a good profit, yet this was the lowest of five bids. A study of this estimate shows that every feature of the work was carefully analyzed and the computations intelligently put together. Another important feature of this transaction is that the cost of each item was kept as the work progressed. When the contract was completed the estimated and real cost could be compared.

The following estimate is a striking example of the lump sum method. The selling price is the only item named, except labor, for which the time is given:

	Selling Price
Material	$130.00
Labor, 4½ days, man and helper	28.00
	$158.80

As these "lump sums" were the only data at hand, and not knowing the real cost, an offer of $144 was accepted. The results of the completed contract were:

	Cost
Cost of material (itemized)	$ 99.86
Labor	22.50
	$122.36
Profit	21.64
Selling Price	$144.00

The profit, $21.64, is almost a delusion. The element of overhead is not included. The overhead was based on productive pay roll and the real factors were:

Cost of material	$ 99.86
Cost of labor	22.50
Expense	11.70
Profit	9.94
Selling Price	$144.00

The first estimated price of $158.80 would have allowed a substantial profit. The estimate was compiled in such a manner as to render it impossible to determine the probable cost. If the original estimate had been put up in something like this form: Material (itemized), $99.86; Labor, $22.50; Expense, $11.70; Profit, $23.94;=$158.00, it would have been seen at a glance that the price could not have been cut to $144.00.

A large percentage of contractors who figure to make a profit do not make a third or a fourth of what they estimate, while many lose money on contracts without knowing it. Most of this is due to bad estimating and failure to check up the cost of each completed item with the estimate. This is particularly true of small work. Here is an example of a loose estimate lump sum, for $80, which was named for the selling price.

After the selling price was named the make-up worked out was:

Materials	$51.00
Incidentals	5.50
Labor	24.00
	$80.50

Results of Completed Contract.

Materials	$46.25
Labor	20.00
Cost	$66.25
Profit (supposed)	13.75
	$80.00

The expense of conducting business, or overhead, on this job was $10, calculated on the productive labor methods, the real profit was, therefore, $3.75.

This estimate is faulty, because the cost of material expense and supposed profit are lumped together instead of being separated. How much more intelligent this estimate appears when put together as it really should be:

Cost of materials (itemized)	$46.25
Cost of labor	20.00
Expense	10.00
Cost	$76.25
Profit	3.75
Selling Price	$80.00

Probably the most surprised of all in this transaction would have been the compiler of this estimate in lump summing it, to learn of the narrow margin of $3.75.

The lump sum method shows nothing but the selling price and cannot be commended for accuracy or profitableness. It is an easy method, but deceptive, because the selling price is not analyzed into its component parts. The amounts allowed for material, labor, incidentals, overhead and profit are not shown. The price named is not developed out of an experience and accounting, but because the amount named seems to be the prevailing price. This class of estimates is used because the price has been fixed, either by competition or some other circumstance, it being assumed that the cost of performing the work would be less than the selling price. Another undesirable feature is that the one who estimates by the lump sum method does not generally keep a record of the cost of each contract, and has no means of determining whether there is a gain or a loss. While the amounts of the above illustrations are small, the principle is precisely the same for estimates of any size.

The unit method is the most accurate estimating system; its value consists in detailing every unit of material and labor required. It also lessens the chance for omissions, underestimating and other errors. It consists in taking each part of the work as a unit.

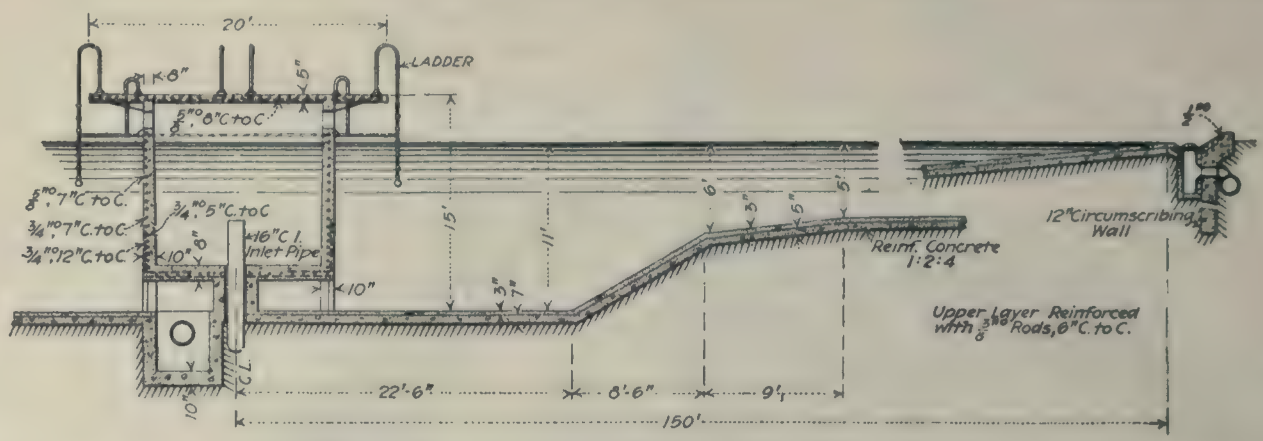
This system adapts itself very readily to nearly all lines of building work. For instance, the number of feet of conduit for electrical work, flooring, or roofing can be considered as a unit. The cost of this material and the labor of installation completing the unit makes the estimating comparatively easy and accurate. This system is more accurate in taking work from the plans, as different portions can be checked against the work shown on the drawings. Another feature in its favor is the ease with which the estimated cost and real cost can be compared. This method takes a little more time, more painstaking, more detailed work than the lump sum, but estimating is too vital a part of the business to be slighted, or lumped, because somebody is in a hurry.

Improved Type of Concrete Swimming Tank

THE ordinary swimming tank is generally rectangular in section of more or less limited capacity. A certain amount of disagreeable congestion arises; for example, the swimmer who essays to test his power in the long-distance sprint is often in the way of the man who is preparing to dive from the spring board. In order to provide suitable swimming facilities under conditions closely resembling natural resorts, the town of Agawam, Mass., built a circular tank, the following description of which appears in the Engineering News-Record:

There has recently been built near Springfield, Mass., a large outdoor pool, which is novel in that it is circular in plan. It is located in an amusement resort known as Riverside Park, in the town of Agawam, Mass., on the west bank of the Connecticut River, which is now polluted beyond bathing use by sewage and factory wastes. Water is pumped from the river and passed through mechanical filters.

After a careful study of conditions it was determined to build a circular pool, the depth of water to increase gradually to a point near the centre, where it should be 6 feet deep. At this point the floor was dropped more abruptly so as to give a space around the centre diving platform, where the water would be 11 feet deep. With the usual rectangular pool those wh



Half cross-section of circular concrete swimming pool at Agawam, Mass.

cannot swim wade in the water at the shallow end, while the other is used for swimming and diving. As fully 75 per cent. of the people who visit a public swimming pool cannot swim, one end of such a pool is badly crowded, the other, or deeper end, being used by the comparatively small number of swimmers.

A circular pool has many advantages. It is impossible for one to fall into deep water from the shore.

The maximum amount of space in which non-swimmers may bath is attained, and if any of these should wade out beyond their depth, it is easy for a guard, stationed on the diving platform at the centre, to reach and help him. The locating of the diving platform at the centre gives the swimmers who wish to use it a better chance as only those who can swim can reach the platform. Swimmers also can pass beyond the wading space and find a part of the pool which is not crowded. The circular pool also makes possible a much larger beach area—a very important adjunct to a swimming pool.

This pool, which is one of the largest in the United States, is 300 ft. in diameter, is built approximately 900 feet back from the river and at an elevation which makes the water level in the pool 50 feet above that in the river. It has a capacity of 2,000,000 gallons.

Method of Construction.

An under base varying in thickness from 3 to 7 in. was first poured. This consisted of one part cement, two parts sand and four parts stone, which left a reasonably even surface. No reinforcing steel was used in the under base. The upper layer of concrete was put in 3 in. thick over the entire surface and was reinforced with 3/8 in. round rods placed on 6 in. centers in both directions. For waterproofing, hydrated lime was used throughout the entire upper layer, being incorporated with the concrete in the mixture. This has proved satisfactory, for although careful watch of the pool has been kept since it was put into commission no appreciable leakage has been found at any point. One-half inch of the upper layer was put in as a finish, this being added before the other 2½ in. had become set. The ½-in. finished surface was made up of one part of Medusa white cement and 1½ parts of sand, the surface being smoothly trowelled. This white cement proved very satisfactory, for although no special white sand was used a very light surface has been obtained.

Expansion joints to the full depth of the 3 in. upper layer, dividing the surface into 25 ft. squares, were left when the concrete was poured. After they had set they were calked with oakum, poured nearly full of hot asphalt and finished with cement of the same mixture as the ½ in. top surface.

Pumping Equipment and Method of Operation.

To supply water three De Laval horizontal single stage centrifugal pumps were installed, two of these, having a total capacity of 3000 gal. per minute, being located at the pump house and supplying water to the pool through a 16 in. cast-iron pipe-line. The water before entering the pool is passed through a battery of fixtures of the pressure type. The third pump was placed in a house built over a well located in the overflow line from the pool. This pump was used to recirculate water, which was again passed through the filters before re-entering the pool.

All water entering the pool is filtered and discharged into a chamber at the centre. It overflows from this chamber into the pool, where it is evenly distributed toward the circumference, overflowing into an open concrete gutter extending around the edge of the pool. In this manner the shallow water at the outside of the pool, which on a warm sunny day tends to become heated, is constantly being replaced by cooler water from the centre. This arrangement also gives an ideal surface skim, and any lint which may come from bathing suits is quickly washed into the gutter at the edge.

As the pool is used for both day and night bathing, a proper lighting outfit was necessary. This consisted of one pedestal and twelve pendant lights, mounted on a pole at the centre, giving a lighting capacity of 52,000 candle power, making it possible easily to read a newspaper at any point on the edge of the pool.

A bath house 64 x 212 ft., fitted with lockers to accommodate 3000 bathers, was erected. This was built with a lobby extending across the centre of the building dividing the men's section from that occupied by the women. Each section was fitted with toilet room and shower baths, and the whole was planned to be well lighted at night. In the basement a complete steam laundry and sterilizer washes and dries all bathing suits and towels. Last summer the bath house often was occupied to its capacity and during a hot spell the bathers would average 5000 a day for a week.

In leaving the pool for the past winter, of record severe cold, the water was drawn down until it measured 5 ft. in depth in the centre part; not a single crack developed in the concrete floor or the walls of the pool.

Mainly Constructional

East and West—From Coast to Coast

The King Construction Company, Limited, has been incorporated with a capital of $40,000, head office at Toronto.

The Union Engine & Machine Works, Limited, has been incorporated, with a capital of $150,000, head office at Montreal.

During the month of May there were 177 building permits issued in Winnipeg, Man., at an estimated value of $295,000.

The Midland Iron & Steel Company, Limited, has been incorporated with a capital of $1,000,000, head office at Midland, Ont.

The Vickers Contracting Company, Limited, has been incorporated with a capital of $10,000, head office at Vancouver, B.C.

Work has already commenced in connection with the new plate mill at Sydney, N.S., for the Dominion Steel Corporation; construction is to be rushed with all possible speed.

Halifax Shipyards, Limited, is the name of the firm recently incorporated for the purpose of establishing a big shipbuilding plant at Halifax, N.S. The company's head office is at Montreal, and their capital is $6,000,000.

The Clyde Engineering Company, Limited, has taken out letters patent of incorporation, and is authorized to carry on the business of mechanical engineers, dealers in machinery, metals, etc., with head office in Montreal; capital $100,000.

Permits have recently been issued in Toronto for the erection of two new schools by the Board of Education, one on Perth Avenue and the other on Bolton Ave., at a cost of $93,000 and $100,000 respectively. Both will be three-storey structures, of red brick and stone.

Building permits to the value of $53,350 were issued in Regina, Sask., during the month of May, an advance of $7,325 over the same month in 1917. The total value of the permits for the first five months of the year is $529,010, as compared with $104,115 for the same period last year.

There were 56 building permits issued for the first five months of the year, in Peterboro, Ont., the total value being $111,795. The largest permit included is for the reconstruction of the store of R. Neill Co., Ltd., at a cost of $35,000, which was wiped out by fire last January. Only five permits were issued for dwellings.

There were 261 building permits issued in Montreal during May, valued at $658,680, as compared with 262 permits, valued at $490,054 in the same month last year. The total for the first five months of 1918 is 635 permits, at a value of $1,742,005, while for the same period last year the figures were 670, valued at $2,108,914.

The first large concrete vessel to be launched in England has been built for Government service. She has a displacement of 900 ton Twelve British companies formed to build vessels of concrete have been registered, their capitals ranging from $25,000 to $3,000,000. The one with the last named capital is the Marine & General Concrete Construction Syndicate, Limited.

An amended Order in Council respecting the continuation of the St. John harbor works by the new contractors, the St. John Drydock & Shipbuilding Company, was passed on June 6. Provision is made only for necessary expenditures to meet the harbor requirements of the new drydock and shipbuilding plant to be established by the company. The total cost of the work planned for this year is estimated at $500,000.

Building Inspector McKenzie's report for the month of May indicates considerably increased building activities in Vancouver as compared with last year. The building permits issued during last month number 67 and are valued at $261,845, while for May, 1917, the figures are 54 permits, at a value of $47,975. This year's total up till the end of May is 311 permits, value $606,555, and the 1917 total during the same period was 222 permits, value $281,339.

The contract for the new office building for the Dominion Government at the corner of O'Connor and Queen Streets, Ottawa, has been awarded to Bate, McMahon & Company, of that city. Their tender, $1,969,000, was the lowest of several received. The structure is being built from designs prepared by the chief architect's staff of the Department of Public Works. It will occupy a portion of the block on O'Connor Street between Queen and Albert, and is to be 200 feet long by 150 feet wide, and nine storeys high above the sidewalk.

The works committee, of Toronto, have recommended to the city council their concurrence in an agreement between the Harbour Commission and the T. Eaton Company, whereby the latter lease 2.95 acres of property on the waterfront between Yonge and Bay Streets, including part of the section of land known as Bayside Park. The Eaton Company have also an option on .611 acre to the east of this property and the effect of the agreement will be to give them a solid rectangle, south of the proposed railway viaduct. It is on this site that they intend erecting their large new mail order building.

The Ontario Railway and Municipal Board has completed the hearing of the argument by the Toronto-Hamilton Highway Commission, York County and the city of Toronto as to the new bridges ordered at Mimico, Etobicoke and Port Credit, on the Toronto-Hamilton Highway. The decision is in favor of concrete structures, instead of steel as provided in the original plans. Estimates of cost were approved as presented by Engineer Geo. Hogarth, of the Provincial Department of Highways. His figures, which show not only the cost of the structures actually to be built, but also the estimated amount which would be necessary to erect standard county bridges, are as follows: Etobicoke—Commission's bridge, $14,863, standard county bridge, $9,418.50; Mimico—Commission's bridge, $21,849, county bridge, $13,657.94; Port Credit—Commission's bridge, $20,798.90 county bridge, $16,749.90. Construction of these new structures will now proceed, the allotment of the proportional charges being determined later. In the event of variation in actual from estimated costs, the ratio between the cost of the bridge the Commission erects and the standard county structure will be adhered to.

Personals

Lieut.-Col. Ibbetson Leonard, of London, Ont., associate member E. I. of C., has been awarded the D.S.O. He is a member of the firm of E. Leonard & Sons, boiler and engine makers

Lieut.-Col. George Eric McCuaig, of Montreal, has been made a Companion of St. Michael and St. George. He is an associate member of the Engineering Institute of Canada, and was among the first to offer his services to the country.

Mr. Henry Japp, president of S. Pearson, Son & Partners, Canada, Ltd., Montreal, a subsidiary of the well-known English firm of contractors, has been made a Knight of the newly established Order of the British Empire. His name was included in the Birthday honours list. Sir Henry is a member of the British War Commission to the United States. He is a member of the Engineering Institute of Canada.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Bienville, Que.

Town Council contemplate the construction of a concrete reservoir. Engineer, C. Lessard, 147 Mountain Hill, Quebec.

Tenders are being received by the engineer, C. Lessard, 147 Mountain Hill, Quebec, for 12-inch deep well pump, capacity 150,000 gallons daily, electric, for the Town Council.

Chicoutimi, Que.

The municipalities of Chicoutimi and Jonquieres are constructing a road twenty miles long. Engineer, M. Henry, Parliament Buildings.

Colchester South Township, Ont.

Plans and specifications are with the clerk, J. H. Madill, Harrow, who will receive tenders until July 12 for drainage work for the Township Council.

Leamington, Ont.

Town Council contemplate the construction of a 12-inch sewer. Clerk, R. M. Selkirk.

Matane, Que.

Roads Department, Provincial Government, Parliament Bldgs., Quebec, contemplate the construction of a road 45 miles long. Secretary-treasurer, Chas. Thibeault, Ste. Anne des Monts.

Matheson, Ont.

Town Council contemplate the erection of a waterworks and electric light plant. Clerk, H. Geo. Ginn.

Mimico, Ont.

Town Council contemplate the construction of sewers.

St. Lambert, Que.

The Roads Department, Provincial Government Parliament Bldgs., Quebec, contemplate the construction of a road from here to Levis. Engineer, M. Henry, Parliament Bldgs., Quebec.

Shawenegan Falls, Que.

City Council contemplate the construction of 12 inch concrete pavement on Fifth Avenue, from Tamarack Street to Station Street and will call tenders shortly. Clerk, J. E. Meunier.

Tara, Ont.

Tenders are being received by the clerk, Neil McDougall, for the construction of concrete culverts for the County Council.

Tuckersmith Township, Ont.

Tenders will be received by the clerk, D. F. McGregor, Seaforth, until June 22, for the construction of the Watson drain for the Township Council.

CONTRACTS AWARDED.

Essex, Ont.

Frank Brown & Son have the general contract for the construction of cement sidewalks for the Town Council.

Hamilton, Ont.

J. D. Armstrong, 138 Erie Ave., has the contract for the construction of a sewer on Murray street, and J. J. Armstrong & Son, 116 Burris St., the contract for sewers on Mary & Tisdale Streets, for the City Council.

Ottawa, Ont.

The Ottawa Fireproof Supply Co., 539 Sussex St., have the contract for pipe in connection with the construction of a $3,600 sewer for the City Council.

Portage La Prairie, Man.

Wm. Carr has the contract for culverts for the Town Council.

St. Catharines, Ont.

Rymer & Longley, 19 Wolesley Ave., have the general contract for the construction of concrete walks and curbs for the City Council.

Vita, Man.

Michael Bodnarchuk, Nykola Hawryliuk and Jacob Myktiuk have the general contract for the construction of roads costing $32,000 for the Municipal Council.

Railroads, Bridges and Wharves

Arthabaska, Que.

Bids for the erection of a steel bridge for the Arthabaska Municipality have been received from the following: Jos. Gosselin, Levis, Levasseur & Fortier, Victoriaville, Jos. Laroche,. Arthabaska, A. Quesnel, Arthabaska, Nap. Dumont, Riv. Du. Loup. Secretary-treasurer, C. R. Garneau, Arthabaska..

Bruce County, Ont.

Tenders will be received by the superintendent, D. J. Izzard, Port Elgin, until 6 p.m. June 21 for the erection of two reinforced concrete bridges for the County Council. Plans and specifications wilth the Superintendent and Engineer, R. McDowall, Owen Sound.

Dufferin, Man.

Tenders will be received by the secretary-treasurer, F. W. Kirby, Carman, until 5 p.m., June 28, for the construction of two pile bridges for the Municipal Council.

Dundas, Ont.

Town Council contemplate the erection of a $3,000 concrete bridge. Engineer, E. H. Darling, Spectator Bldg., Hamilton. Clerk, J. S. Fry.

Elora, Ont.

Tenders will be received until noon, July 1, by J. P. Mundrel & Co., Ltd., and U. Richardson, M.P.P., for the construction of a concrete dam over the Grand River for the Town Council.

Osgoode Township, Ont.

Tenders are being received by the clerk Frank Iveson, Metcalfe, until July 2, for the erection of a bridge over Castor River for the Township of Metcalfe. Magwood & Stidwell, Cornwall, are the engineers.

St. John, N.B.

Tenders are being received by the clerk, Herbert E. Wardroper, until 11 a. m. July 2, for the construction of an addition to ferry wharf for the City Council. Plans and specifications are with the engineer, Geo. N. Hatfield.

CONTRACTS AWARDED.

Brome, Que.

C. J. Dryden Co., Ltd., care of secretary-treasurer, Geo. F. Hall, have the general contract for steel bridge for the Township Council.

Levis, Que.

Miles Loneigan, 1254 St. Valier St., Quebec, has the general contract for improvements costing $125,000 to electric railway for the Levis Co. Ry., Commercial St., Levis.

Grimmer Parish, N.B.

Fred E. Rivard, St. Leonard, has the general contract for $3,446 bridge for the Department of Public Works,, Dominion Government.

Margaree, N.S.

Morris A. Condon, Digby, has the general contract for the construction of a breakwater for the Department of Public Works, Dominion Government.

St. David, Que.

Cie de Construction de Nicolet, care of secretary, J. W. Joyal, St. David, have the general contract for bridge and abutments costing $5,494 for the Town Council.

Sutton, Que.

Mr. Poulin, Marieville, has the general contract for $24,000 reinforced concrete bridge for the Township Council of Sutton, Town Hall.

Vancouver, B. C.

W. Greenless has the general contract for repairs costing $3,650 to Fraser Avenue bridge for the Department of Public Works, Provincial Government.

Wellington County, Ont.

The following contracts have been awarded for the construction of bridges. etc. for the County Council: 135 ft. steel bridge, Sarnia Bridge Co., Sarnia; abutments, Chas. Mattani, Fergus; 55 ft. concrete arch truss bridge. John Pilker, Harriston; two concrete beam bridges, W. Vallery, Bellwood; 80 ft. concrete arch truss bridge over Irvine River, Chas. Vattani, Fergus; 35 ft. concrete beam bridge, W. Vallery, Bellwood.

Westmorland County, N. B.

Power & Brewer, 107 Prince William St., St. John have the general contract for $21,500 concrete arch bridge for the Department of Public Works, Dominion Government.

Public Buildings, Churches and Schools

Beulah, Man.

Tenders will be received until July 3 for the erection of a $15,000 school for

ESTABLISHED 1886

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Industrial Reconstruction and Scientific Research

AN organization which has great possibilities for usefulness is the recently formed Canadian Industrial Reconstruction Committee, comprising some of our best-known industrialists, financiers and educationalists. At a recent meeting of this committee a report from the executive was considered and one of the chief topics of discussion was the establishment of research departments and scholarships in our universities.

The committee apparently take it for granted that a National Research Institute will be established at Ottawa in the near future along lines suggested by the Advisory Council for Scientific and Industrial Research, and the report suggests that a close co-operation between this institute and the research work of the universities is desirable as being certain to result profitably for both organizations.

There is the greatest need at the present time in Canada for the prosecution of research work. It is generally recognized that industrial competition after the war will be keener than anything the world has ever seen. Germany's condition, commercially, will be desperate, and there is no question but that she will make every possible effort to regain the position the war will have lost for her. Much of Germany's prominence, industrially, was the result of scientific research work carried on by their universities and other organizations subsidized by the German government, and in this respect they undoubtedly led the whole world. It would surely be foolish for us to close our eyes to these facts and refuse to profit by the experience of the past. Unless we speed up on research in manufacturing, we shall soon have lost all the advantages that will have been gained by isolating German commerce for the duration of the war. To accomplish the desired ends it will be necessary not only that ample facilities be placed at the disposal of our research workers, but also that sufficient encouragement be offered in the way of remuneration that our very best and cleverest young scientists will be attracted to this work.

So far as the manufacturing interests themselves are concerned, there seems to be no question but that they are now coming around to the viewpoint where they will support any expenditure the Government may make in this direction. We believe also that the people at large are of the same mind. The whole question of whether Canada becomes a considerable factor in the industrial progress of the world or whether she settles into the class of purely agricultural countries, hinges, as we believe, to a very great extent, indeed, on what action our government takes within the next few months on this very important question of establishing research facilities where manufacturers, engineers, contractors and industrialists of every kind may bring their problems for discussion and solution.

The initial expenditure of a million or two of dollars may look large at the moment, but is likely to prove insignificant compared with the advantages that must ultimately accrue to the country at large. We trust our government will lose no time in preparing plans and furthering the erection with all possible speed of research laboratories, not only in Ottawa, but in numerous other prominent industrial centres throughout the Dominion.

Research facilities in our universities would supplement the usefulness of such laboratories in many ways. They would be in a position to carry on research work into the more purely scientific problems and, perhaps still more important, would constitute training schools from which the research scholars for the industrial laboratories would be drawn.

Hamilton Branch I. E. C.

HAMILTON engineers have fallen in line with the general movement towards greater co-operation among Canadian members of the engineering profession, and at a recent meeting held in the Royal Connaught Hotel they decided to form a Hamilton branch of the Engineering Institute of Canada. Some fifty engineers were in attendance at the gathering, Mr. J. L. Weller, Chief Engineer of the Welland Canal construction, presiding. Mr. Fraser S. Keith, the general secretary of the Institute, was also present. Mr. Keith addressed the meeting, explaining the necessary procedure for the formation of the branch, and spoke most hopefully of Hamilton's prospects as a centre of engineering and industrial activity. A resolution was passed and an application signed, to be presented to the parent body in Montreal. Pending the receipt of the necessary authority for the establishment of the branch, Mr. E. R. Gray, city engineer, was elected chairman and Mr. E. H. Darling, secretary.

The enthusiasm displayed at the meeting bids well for the success of the new branch. There is no doubt that if the engineers of Hamilton continue in hearty co-operation, they will become a big factor in the growth and development of their city and community, and incidentally in raising the status of the engineering profession. It was suggested that engineers should be more aggressive in taking their place as public-spirited citizens and should co-operate with the Board of Trade and other public bodies in advancing the material interests of the community. That all present were in thorough accord with this view shows that Hamilton engineers have caught the true spirit of co-operation and that they are progressing in the right direction.

Another point to be remembered, too, is that the action of the Hamilton engineers reflects credit on the Engineering Institute of Canada. That they have decided, as did the Halifax engineers a short time ago, to adopt the Institute as a parent, would indicate their approval of its aims and objects and their belief in its usefulness, as reorganized under the new name. These vigorous offspring of the Institute will, we feel sure, not only grow and flourish themselves, but will greatly help to increase the prestige and broaden the influence of the whole profession.

How Would the General Adoption of the Cost Plus Contract System Affect the Contracting Business?

THERE are few contractors who will not agree that the present status of the contracting business is not what it should be. It would seem that there are two main causes—more or less interdependent upon each other—to which this condition is attributable. One is the present system of bidding, and the other is the ill-defined field which the designation "contractor" covers. As regards the former, it is undeniable that the practice of a wide-open invitation for tenders and the "lowest bid" award, fosters the unreliable type of contractor, who does not hesitate to obtain a profit, or prevent a loss, by skimping his work. Not only so, but this system often places even the best-intentioned contractor in a position where his honesty is too severely tested. It is a very hard thing to live absolutely up to specifications, when through some unforeseen and uncontrollable contingency, work must be carried out at a loss, while at the same time an unreasonable or unscrupulous owner profits by it. Risks must be taken in every line of business, but the gambling element in the contracting business is unnecessarily great. Nor are all the faults on the side of the contractor; cases are all too numerous where governments or private owners seek to escape their obligations at the contractor's expense.

It is very evident how the second main cause we have mentioned, namely, the ill-defined limits of the contracting field, tends to lower the standing of the contractor. In the public mind, not only does the term "contractor" cover every class of constructor from the jerry-builder to the large engineering organization which can handle an undertaking involving millions, but it also includes the manufacturer who supplies paper soled shoes to the army, the cold storage magnates who hold foodstuffs for high prices until they rot, and all the various classes of profiteers who enter into agreements with the government for the furnishing of supplies. Thus it is that the legitimate contractor becomes the scape-goat for a multitude of sins of which he is altogether innocent.

The primary means by which the contracting business may be elevated to its proper level, is, we believe, the general adoption of the cost plus contract system. This step would place contracting on the same basis as any other business; it would remove the gambling element to a very great extent and make every contractor depend on his record for the obtaining of business rather than on a lucky chance, thus tending to eliminate the inferior type of man who makes most of his profit through skimping his work. Construction men adopting this system in the carrying out of their work would soon become separated in the public mind from the wide class now known as "contractors," and, as a result, would not suffer on account of the reflections cast upon the name by numerous scandals in no way connected with construction work.

There is another means which contractors have been very slow to take advantage of for the protection of their reputation and the increase of their prestige—that is, organization. It is hard to explain why they should hesitate to get together for mutual benefit, particularly that they may oppose the depredations of the irresponsible contractor and raise the general status of their business.

In the reorganization of the present contract system, undoubtedly the most difficult problem to be solved is the letting of government or municipal work. It seems as if the government must of necessity adhere to a system in which every contractor on the list has —apparently—an equal opportunity of obtaining the award. This course has at times been diverted from, and the result has generally been dissatisfaction and charges of favoritism. With the removal of the patronage system the question now would seem to be whether any method can be devised whereby, without the elimination of competition, the possibility of graft or playing politics may be minimized. There are, in this connection, one or two suggestions which we hear from time to time. The first is the registration of contractors for government work. That is to say, every contractor who wishes to participate in government works must register with the authorities, giving particulars as to the personnel of the firm, its capital, plant, and staff. Thus contractors might be classified according to their financial standing and their facilities for carrying on work. The second suggestion is that in connection with government undertakings, the specifications cover not only the work but also the contractor, specifying the organization and capital which he must possess before being eligible for consideration. The third and final suggestion is that there be a definite percentage of profit fixed for government work and that the decision between the contractors desirous and eligible to undertake it be made by ballot in the presence of those interested.

These suggestions may seem somewhat radical and no doubt they may have weak points, but with alteration or modification it is possible that they might form the basis of a system more equitable and more workable than that under which contractors are now forced to carry on their business.

Repairs to Bridges in the Chaudiere Valley

On July 30th, 1917, there was a great rain storm in the Chaudiere Valley, especially severe some sixty miles south of the city of Quebec, when, over an area about thirty miles by eight miles there fell five inches of water in an hour and a half. The result was that the Chaudiere River rose from twenty to forty feet in a few hours, flooding the valley and doing great damage. This article deals with the repair of two highway bridges which suffered, one at Scott's and the other at St. Come.

The 225-ft. span at Scott's was lifted up on a great mass of floating slab wood and turned over on its side about two hundred yards downstream. The steel floor beams and stringers were uppermost, not much damaged, but the trusses were buckled in all directions, some of the posts being bent double. The wooden floor mostly broke away and the lower truss became buried in about three feet of gravel. The flood subsiding, there remained eight feet of water. To salvage the wreckage the accessible floor stringers were cut out, leaving sixty tons of steel work to be dragged three hundred feet to the shore. The structure was raised little by little by shear legs to allow the gravel to fall underneath. When it appeared to rest on the surface of the river bed the hauling tackle was hitched up. This consisted of a five-rope block of 1⅛ wire rope connected to deadman of 24-inch timber, 15 feet long, buried 12 feet. This tackle was pulled by eight part ⅝ wire rope block hauled by four thousand pounds pull hoisting engine. In dragging the steel work to the bank much trouble was caused by projecting steel fouling heavy boulders. As the wreckage came ashore it was cut apart.

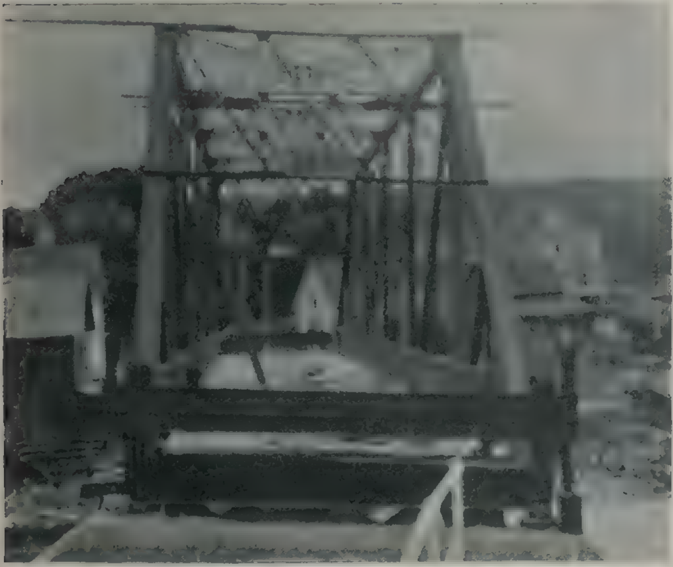


Fig. 1—St. Come Bridge.

One abutment of the 170 ft. span at St. Come was washed out, making it tilt about two feet. The bridge steel weighed sixty tons, Seigwart concrete beam floor one hundred tons, giving normal reaction at each of four supports of forty tons. The steel structure was stiff enough, however, to stand clear of the abutment at the sunken end by about 3 inches, thus producing a load of eighty tons at higher end of the damaged abutment and eighty tons at the end diagonally opposite on the other abutment. Under such unusual conditions the following short account of distortion will probably be of interest. The web members of the portals at both ends of bridge failed in compression as shown on Fig. 1. The intermediate sway frames showed no distress but the posts to which they were attached were bent a maximum of 2 inches at fourth panel from end but none at centre. Bridge leaned over two feet at sunken end and two feet in the opposite direction at other end. Top lateral bracing was not visibly strained. Calculation based on measured distortions of sway frame posts revealed the fact that the greater part of the load transfer was due to the rigidity of the floor beam connections to trusses. No rivet heads pulled off nor rivets sheared.

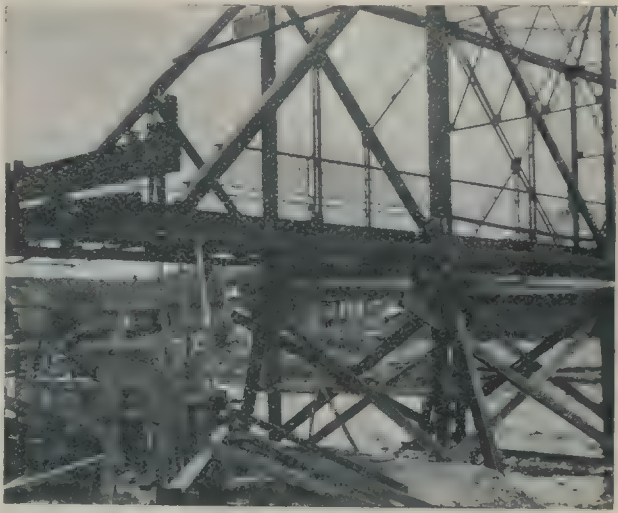


Fig. 2—Showing suspension verticals strengthened by timbers.

To restore the bridge without cutting it apart a special jacking girder was attached across the road above the damaged abutment and jacks arranged for eighty ton lift at each truss end, Fig. 1. After filling up the washout with concrete under the abutment, jacking of the low point was begun. On reaching the proper level it was found that the raised end had much more load than the other, proving that the bridge had received a "permanent set" by being overstrained. To rectify this the jacking was continued beyond the level and the bridge distorted in the opposite direction and then let back to normal. It was then found that equal loads were supported by the two truss ends and that all posts were straight and trusses were plumb. The only parts to be replaced were the web angles of the two portal frames.

Fig. 2 shows the suspension verticals at second panel from abutment stiffened by two 8 x 6 inch timbers so that the bridge could rest on falsework while the damaged abutment was demolished and replaced by a new one.

The repairs above described were carried out by MacKinnon, Holmes & Company, Limited, Sherbrooke, Que.; concrete work by Jos. Gosselin Limited, of Quebec; all under the direction of Mr. L. A. Vallee, engineer of the Department of Public Works and Labour, Quebec.

Present High Prices and Public Utility Rates

WHILE practically every detail entering into a contractor's organization has shown an increased cost. it is interesting to note that electricity is, in general, an exception. Although the use of electricity by the contractor for operating cranes, shovels, etc., is limited to the availability of the power, yet in certain projects such as the Niagara-Chippewa power development scheme, described in our last issue, even although considerable preparation had to be made to make the current available, a saving of some 50 per cent. was effected on the cost of the work.

Why the price of electricity has not been increased since the war, in comparison to other commodities, is probably due to the fact that this increase can only take place under the proper public authority. It has been said that after the war is over prices will drop rapidly. Perhaps the hope of this is one reason why the price of electricity has not advanced. In an interesting address recently delivered before the Wisconsin Gas and Electric Association at Milwaukee, Mr. W. J. Hagenah drew conclusions from historical precedents, and showed that the decline of prices from their present high level, will likely be very slow after the war is over. This, in effect, is what the average business man is inclined to fear.

We are witnessing at the present time a most important development growing out of our disturbed economic and political conditions—one which is destined to have a most far-reaching effect on the operations of public utilities. Economists have for some time foreseen and predicted the condition which is now exerting such tremendous pressure on every form of activity, individual as well as corporate and public as well as private. There is hardly an individual or an enterprise that has not already felt this staggering force or is not destined to feel it in the near future, but among all forms of industry which are staggering to effect a readjustment none has suffered so acutely as have the public utilities. I refer to the steadily rising level of prices, to which such decided impetus has been given by our entry into the great European war.

For over fifteen years before the opening of the European war we witnessed in this country a gradually increasing price level. Coincident with this was our great industrial and commercial development.

The mine owner, the manufacturer, the farmer, the tradesman and the professional man met the rising level of prices by shifting the burden through increased charges for their product or his service, but not so with the utility. Its rates were fixed and could not be increased except by action of the proper public authority. So long, however, as the utility had not yet reached the reasonable limit of its technical development and while the territory which it served was still far from saturation, these increasing costs were largely offset by improvements in apparatus and methods. In fact, there are many instances where in spite of these conditions net earnings, because of especially favorable local conditions, showed annual increases. Electric production units were each year becoming larger and more efficient. The art of distribution and transmission was making great strides. The investment per unit of capacity generally tended downward. At the same time the demand for utility service was growing, and what fifteen years ago was considered a luxury in a short time became a necessity. As long as this condition was present the economies growing out of increased efficiency and service development tended to offset the rise in labor and material prices, but when relatively high efficiency had been realized and the increases in the price level appeared to be gaining in momentum, the trend of net earnings in most instances turned definitely downward. With the reasonable limit of expansion reached, the crisis in the history of the utility industry approached. Between the pressure of increasing costs and the declining purchasing power of the dollar of income net earnings were threatened with extinction. This, in brief, was the condition of the utility industry when in 1914 the storm of the European war burst on the world—a war which each year has enveloped additional peoples and has gained in fury and destructiveness. And with the coming of this war the level of prices, which was already at the highest point reached in a generation, turned abruptly and violently upward, which tendency it has maintained to this time.

Commodity Prices That Go Back a Hundred Years.

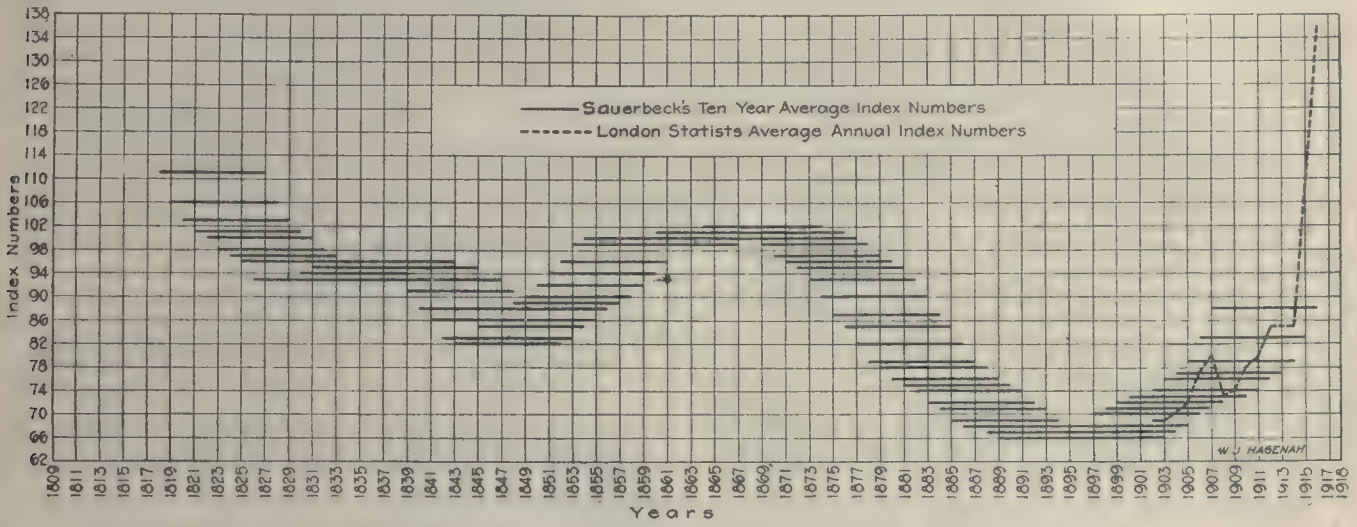
The diagram reproduced with this article shows Sauerbeck's ten-year average index prices for the years from 1817 to 1916, on which I have superimposed the annual index prices of the London **Statist** in order to show what has taken place beyond the period covered by the Sauerbeck data and what the extension of the Sauerbeck data for the next few years will reveal.

Just as the political history of the nineteenth century dates from the Congress of Vienna and the final defeat of Napoleon, so the economic history of that century also begins with the conditions then broadly recorded. The year 1815 is one of those years in history which marks an epoch and the influences of which time extend for many decades. In the next few years we are likely to witness another such epoch-making date, when the world, bled white by war, will close a chapter of great social and economic forces in conflict, in the soil of which mighty political movements will have taken root.

Let me call attention to the fact that from the high-price level following the Napoleonic wars to the high level of the Civil War period was approximately fifty years. Also, following the low point reached in about 1846, it was again fifty years before the low level after the civil war was reached. Singularly, it is now just fifty years since the high level of prices in the Civil War period. In view of these events of the last century covering two complete major economic cycles, in each case growing out of conditions similar to those with which the world is confronted at this time, can it be expected that following the declaration of peace in this war we shall see a quick decline in prices to the pre-war level or lower?

Prevailing Prosperity is Largely Fallacious.

In spite of prevailing conditions, we appear very prosperous at this time, but let us not be deceived. This is a war prosperity, and both England and Germany report the same kind of business activity. However, in view of what we know of conditions, it would be more correct to say that we are extremely busy rather than extremely prosperous, since we are not creating wealth. Our country, along with almost the entire world, is just now engaged under pressure of the greatest necessity in carrying on campaigns which are exhausting the man power and wealth of the world and from which all will emerge as peoples much poorer than before they entered. From this period of intense activity, of strained production and increasing consumption, we shall enter a period after the war when this destruction must be paid for by the hard labor and economics of the people .The reaction will be as great as was the action, but it will be extended over a much longer period of time. This does not mean that we shall at once have a serious depression. On the contrary, the necessity for urgent reconstruction and the accumulation of deferred work, will lead to considerable activity for a year or more after the close of the war; but the period of readjustment and of producing from the soil and other natural resources and by hard labor the wealth to pay for these struggles will cover many years, and during this time we shall undoubtedly experience a relatively high level of prices, but with a gradually declining tendency the world over.



The movement in commodity prices in 100 years of war and peace.

Based on the course of the price movement after periods of great world wars in the past and in view of the special conditions with respect to the currency and banking systems at the present time, we may look forward to a considerable period of high prices, a period of business readjustment and a period of new social legislation. What this means in its full significance to individuals, to business in general, and especially to public utilities, can be readily understood without attempt on my part either to generalize or to go into details.

However, reflect on what it will mean to business to be required to make extension and to finance requirements on this level of prices while operating under a rate schedule determined five years ago if we should not return for fifteen or twenty years to the price level on which such rate schedule was based. What will it mean to business to have to purchase operating supplies on the price level of five years ago? The price level under which plants were built, under which franchise obligations were established and on which rate schedules were established may not again be reached in fifteen years or even longer. There are some who say that prices will decline quickly with the return of peace. Whether they will or not no one definitely knows, but when we stop to consider the extent and destructiveness of this world-wide war and remember the price movement after each of the other two great wars, it is not difficult to believe that many men in this room will not live to see the return to the price level of 1914.

As a result of this violent price movement which we are now witnessing the work of the utility commissions has not only been enormously increased, but the character of their decisions reflects the really constructive purpose of such institutions. During the decade of commission activity extending from 1907 to 1917 the almost universal results of commission investigations were reductions in rates. For the larger part of this period the rise in prices was gradual but extremely moderate in comparison with the last two years; but these increases were in many instances offset by the increased efficiency in utility operations and the great extension in service. So elastic was the industry and so quick its response to reasonable rate reduction that these years, which represent an almost unbroken record of rate reductions, at the same time mark the golden years of utility growth—years during which public utilities reached a point of growth in size and stability comparing favorably with the greatest industries of history.

At the present time, however, the commissions, which were quick to take advantage for the public of every economy in operation or profit resulting from improvements, are now foremost in granting relief from the pressure of high prices. Nearly five hundred public utilities have received increases in rates or have been relieved from burdensome obligations by state utility commissions and by city councils within the last fifteen months, and among this number are companies operating in many of the large centres of population. If the present tendency among state commissions and city councils to permit increases in rates to offset rising costs conpermit increases in rates to offset rising costs continues, the year 1918 will witness a practical cancellation of much of the work for rate reduction accomplished by these same authorities after many years of labor. It will also show that the original conception of a public utility commission as a continuing investigating body created to do justice to investor and public alike was correct, and that even in the midst of this great war, wherein every element of our national life is strained to the utmost, the desire for justice and fair play to all interests is still firmly grounded in the heart and mind of the public.

Important Details in Housing Problems

PERHAPS no project before the public at present is more important than that of housing. That this phase of our industrial progress has not been given due consideration is shown by the conditions which now exist throughout Canada. It is becoming more and more the general opinion among manufacturing heads that the only way to keep men is to provide suitable accommodation within reasonable distance of their work. While this is an important consideration, yet this is not the only reason why housing accommodation is urgently needed at the moment. In Toronto, for instance, there is a general scarcity of houses and the conditions have become so acute that people are living in over-crowded quarters and, in addition, are obliged to pay extremely high rents. Several projects are now on foot to overcome the difficulty in Toronto, while other schemes are in course of development at Brantford, Halifax, Temiskaming, and other points. In order to throw some light on what necessary data must be collected before a housing project is developed, Mr. John W. Alvord, a prominent Chicago consulting engineer, has formulated in the Engineering News-Record the following important features to be observed:

Drainage—It is important to notice that the site can be well drained to ample depths required for cellars. High, slightly rolling or gently sloping land at least 15 to 20 ft. above an available outlet in the immediate vicinity is highly desirable and ideal.

Low Lands Available—Low marshy land with no marked drainage lines is not to be entirely avoided, because it can probably be developed, but at considerable expense for grading or pumping the sewage and drainage, which expense must be added to the cost of the land and should be kept in mind for purposes of comparison.

Marked Natural Drainage—Gently sloping land, with well marked natural drainage lines traversing it, is desirable, as the cost for natural drainage is lessened and desirable open spaces are increased.

Broken Land—Very broken land, with accordingly rugged topography, all requiring a great deal of heavy grading to render it habitable, is to be avoided for present purposes.

Desirable Sandy Land—Sand soils, with low ground-water level and good outlet, are desirable, although expensive to develop fully. The disadvantage of expensive black soil importation offsets in part the naturally good drainage, dry cellars, and cheap storm water removal available.

Undesirable Sandy Land—Sandy soils with high ground water and poor outlet facilities are expensive, for the construction of underground work.

Clay Soils—Close clay soils are not entirely desirable, as surface drainage will be largely increased, especially where steep slopes prevail. Stiff clay makes for expensive pavements, imperatively needed, and often cellar drainage must be especially provided.

Gravels and Sands—Sandy gravel, even containing some clay, makes an excellent site, particularly when porous and combined with low ground-water level Such a site needs a minimum of street pavement or, at best, inexpensive pavement, and the drainage system will be much cheapened. Excavation is also less costly than in some other soils.

Sites Best for Streets—The topography best suited for streets will furnish grades less than 0.3 or 0.4 per cent and not greater than 4 per cent.

Corporate Limits—It is important to note whether the proposed housing site is inside corporate limits of the municipality, and, if it is not, to ascertain possibility and terms for connections with existing municipal public utilities.

Important Sewerage Details.

Connection to Existing Systems—The available outlet for the sewers must be fully investigated. If this is through an existing sewer in a neighboring sewer system, ascertain if it is large enough, where it empties, and what, if anything it imperils. Report type of sewer system, whether sanitary, combined or storm water.

Note approximate drainage areas, direction of flow and relative surface elevations, with particular reference to the necessity and approximate size of storm sewers and open ditches.

Long Outlet—If long outlet sewers are necessary for connection with neighboring sewers, ascertain their cost and how this may compare with other possible outlets.

Legal Status—Investigate if local sewers in adjacent systems can be legally used without payment. If proposed housing quarters are outside corporate limits, can connection be made with sewers in the corporation?

Special Assessment Laws—Always check general statements about the use of adjacent sewers by consultation with the city authorities and particularly see the special assessment laws and ordinances by which such sewer districts were formed and such sewers paid for.

Constructive Questions—Ascertain soil conditions as to cost of construction on the proposed site. Will the banks stand up alone? To what depth? Quicksand? Rock? Ground water?

Local material—Are there local supplies of building material? Lumber? Cement? Sand? Gravel? Broken stone? Prices?

Local contractors—Are there local contractors and builders? What equipment is available, such as trench machines, concrete mixers, grading outfits, steam shovels, teams, motor trucks? Find recent contract prices for sewers, paving, curbs and sidewalks.

Transportation—What are the railroads with and transportation facilities for delivery material?

Local labor—Investigate local labor situation with reference to available carpenters and laborers.

Selection of Sewer Outfalls.

Outfalls to be First Considered—As the sewerage and drainage are in many ways affected by the ultimate method of sewage disposal, it is essential that investigators should obtain the data for the proper solution and approval of that problem.

State Control—In most states the state board of health has control of the sanitary standards to be observed, and in some cases they issue rules, directions and, in other cases, have well defined policies which it is important to know and follow.

Detailed Approval by State Authorities—Where state board of health or other authority controls stream pollution, it is usual to find that the law provides that it has final approval of all plans and specifications. This should be kept in mind.

Extension of Existing Facilities—In localities where sewerage facilities exist, extension of such facilities is presupposed, unless the state authority or good practice requires their revision or rejection.

Local Practice—In developments which are contiguous to municipalities or are parts of municipalities, the practice and method of such municipality should be followed if good, and followed and supplemented by good practice where desirable.

Isolated Developments—Where developments are not adjacent to settled territory of any description, standards must be outlined, future expansion taken into account and especially complete information obtained.

Stream Pollution—In general, streams should not receive raw sewage from isolated developments unless the extreme low-water flow of the stream exceeds about 5 cu. ft. per second for each 1000 of the probable future population.

Provision for Future Tankage—In every case, where possible, outlet sewers should be at such elevation that sewage treatment by tankage can be readily introduced in the future, if required.

Outlets—In the cases of all considerable streams into which the contents of sewers are discharged, good practice would suggest that submerged outlets conveying the normal flow should extend out into water of such depth that the sewage will be quickly diffused and not easily observable. Overflow at the shore line may provide for abnormal flow.

Tidal Outlets—In cases where outlet sewers empty into tidal estuaries, special studies are necessary to be assured that freedom from offensive conditions will be obtained. In some cases, where elevation is lacking, it may be necessary to store the sewage temporarily during high tide; and in other cases it may be desirable for other reasons to release the sewage from storage reservoirs on the falling tide only.

Partial Treatment—In cases where the low-water flow of streams available for sewerage is less than about 5 cu. ft. per second for each 1000 of ultimate future population served, treatment works should be planned for, and if the population in the near future requires such works should be introduced more or less completely, as circumstances appear to render necessary.

Complete Treatment—In cases where the sewage must be emptied into a stream quite insufficient in flow to deal properly with it, treatment works of a reasonably complete character must be introduced.

Complete Plant for Extreme Cases—No sewage or polluted storm water should be discharged into a stream used as a source of domestic water supply at any point where it may possibly contaminate such water supply, except in the most extreme cases, when it is absolutely unavoidable to divert the sewage from a stream used as a source of water supply, treatment plants of the most complete and reliable character should be introduced. A site involving the above conditions is undesirable, and should not be selected if it is possible to avoid it.

Provision for Future Treatment—Where it is likely that while the present population may safely empty sewage into streams, the future population can probably not do so. Space and elevations should be left so as to provide for the possible future installation that may be necessary.

Treatment Sites Removed from Population Areas—Sewer outfalls liable to require treatment plants should not be located in or near thickly populated or residential property, if it is possible to avoid it.

Long Outfalls Avoided—Long outfall sewers are to be avoided if possible, where the liability to introduce treatment works is only a future possibility. Short outfalls to the nearest outlet may be selected, but at such elevation that intercepting sewers to more distant outfalls can be introduced when found necessary.

Water Supply Details.

Extension of Existing Facilities—Available water supplies already developed should be examined in detail, to ascertain that they will be satisfactory from the standpoint of (a) quality; (b) quantity, and (c) pressure.

Water-Works Information—Water-works information should include: (a) Type and capacity of pumps; (b) average daily supply; (c) population served; (d) pressure near point of extension; (e) relative elevation of proposed site; (f) size of main supply pipes to site; (g) reservoir and standpipe elevations or storage.

Cost of Connecting Mains—Where connecting mains outside of the site are not sufficient in size or are deficient in pressure, the cost of supplying these deficiencies should be approximately ascertained, if possible, and also inquiry should make known whether that cost will be assisted by the municipality or water company.

Water Rates—Ascertain whether water is sold in adjacent territory by meter or flat rates or in part; both what these rates are and what policy the water company or department will have in the matter of the housing development, particularly if the proposed housing quarters are outside of the corporate limits.

Cost—Ascertain whether the extension of water mains within the housing development site will be a direct charge or will be amortized in the rates.

Pressure—Find out whether the pressure is deficient, whether new and higher pressure can be generally installed, whether a high service district is necessary, or whether booster pumps or storage will be needed.

Fire Engines—Ascertain whether fire engines are used or extra fire pressure, developed at the pumping station, is used for fire service.

Poor Supply Quality—Water supplies from surface supply unfiltered are to be looked upon with suspicion, and, generally, arrangements should be urged, if possible, for their filtration or, at least, sterilization.

Contamination by New Housing—Water supplies in adjacent developments should not be imperiled by the installation of the new housing developments in such manner that the sewage will reach their source.

Special Report—If entirely new supplies must be developed an experienced water-works engineer should report especially on the possible source and the cost of construction and operation, and should show the resulting rates as well.

Streets and Pavements.

Situation—Note location of the proposed housing site with reference to street connections of the municipality. Is the site on a main thoroughfare? Will extensive street work be required to connect the housing site with the business and factory sections?

Soil and Drainage—As a well-drained site or one with gravel soil may materially reduce the necessity for expensive improved pavements, these features should be specially observed.

Grades—The best topography for street grades will run not less than 0.3 per cent. or 0.4 per cent and not greater than 4 per cent. Note the extent of grading required for streets and houses.

Local Practice—Observe the local practice as to types of pavement, street and pavement widths, curb and gutters and sidewalks, particularly where there are recently built industrial housing quarters, or new real estate developments. Note whether alleys are used.

Local Materials and Prices—For approximate or comparative estimates, note the availability of local paving materials and prices, also recent contract prices for pavements, curbs and walks.

A good description of the local electric-light plant and gas company should be secured. Have they capacity ? How connected up to site? Cost? By whom paid? Report on local methods of street lighting.

Investigate rates. Is there dissatisfaction in the community? Is it reasonable? Or unreasonable ? Hear both sides to any controversy. Compare rates with other similar situation. See if there is any reason for abnormal rates. Are rates governed by State or other utility commission?

Is service good? Quality of gas? How determined? What ordinance requirement? Electric light: Are there breakdowns and stoppages? Why?

Will companies finance complete installation and authorize through rates or expect cash cost advance and rates accordingly-

What contractural relations otherwise may be reasonably expected?

Compressed Air and Its Wide Use in Contracting Work

AT the present time when the shortage of man power is so acute, necessity has resulted in an ever increasing demand for a means of conserving man power as much as possible. While compressed air has now almost universal use in the mining industry, its great service to the contractor is possibly not fully appreciated. For certain kinds of work—pumping water through direct acting pumps, for instance—compressed air is too expensive as compared with steam to warrant its use, but the problem of whether one is justified in using a compressed air plant on a contract is largely governed by the proper choice of equipment. The following article by Walton I. Aims, in "Contracting," gives an outline of the possible use of compressed air in ordinary construction work:

Recent Developments.

Improvements made during the last few years in machinery and in methods of installation have greatly increased the profitable use of compressed air, by effecting economies in the cost of plant and operating expenses.

In the matter of drilling rock either in trench or open excavation the wasteful and cumbersome steam-driven tripod drill requiring two men to operate has largely been superseded by the one-man pneumatic hammer drill which is now made to bore holes to a sufficient depth for all ordinary requirements at a great saving in cost per foot of hole.

Convenient Portable Compressor.

On small jobs of this character a handy rig for furnishing compressed air consists of an air receiver mounted on wheels, on top of which is bolted an air compressor driven by a gasoline engine with an unloading device on the air cylinder and a fly wheel governor on the engine the machine is automatic and requires but little attention.

Uses for Various Purposes.

For working small derrick or shear leg hoists several handy air motors are made that can be bolted directly to the mast or shear legs and the work of hoisting and placing is thereby greatly facilitated.

The advantages of air riveters, caulkers, chisels, reamers, and wood-boring tools over similar tools operated by manual labor is well known, when the quantity of such work is sufficient to warrant the necessary plant outlay.

When any amount of cement grouting is required grouting machines operated by compressed air will do more than double the work at less than half the cost of pumping grout either by hand or by power.

For pulling and hauling a handy little winch run by air will often do the work of 10 men.

An air hoist hooked to a "trolley" running on the bottom flange of an I-beam makes a very useful traveling derrick for unloading, storing, and reloading heavy material.

Although the use of compressed air as power for pumping water through direct acting pumps is expensive, as compared to direct steam it often has proved of value in emergency or in temporary work and when properly applied in the air lift is reasonably economical.

Where open-bottom steel pipe piles are to be driven it is sometimes possible to clean out the interior of these piles by dropping a 2-in. or larger pipe inside the pile and blowing the material out by compressed air.

A rock drill of about 3½-in. diameter easily can be made over by a blacksmith into an efficient sheet pile driver where only a light hammer is required. This drill either can be suspended from a light derrick or may be rigged up to run on a wire cable or other overhead runway over the line of sheeting, and, operated by air, will often do cheap and rapid driving.

Opportunities also may arise for the use of the cement gun, the sand-blast, or the pneumatic paint brush.

In cramped or obstructed concrete work, such as the placing of the arch of a tunnel lining, the method of mixing and placing concrete by compressed air has been employed successfully.

With the exception of the last mentioned, the bulk of these machines require but comparatively little air, at a pressure of 60 lb. or less, so that the original plant installation, if for rock drilling, for instance, is abundantly able to take care of them.

The above are a few of the many applications of compressed air to the exigencies of the work in hand as they may arise during its prosecution, if conditions have warranted the original plant installation.

Choice of Compressors.

On work where the possibilities of using compressed air are small, a gasoline-driven compressor, such as has been previously described, may best answer the purpose, but where larger quantities of air can be used to advantage a central power station is advisable. This may be either steam or electric driven.

With steam the question at once arises as to choice of machines. Shall the compressors be Straight Line, Duplex-Compound Steam, Compound Air, or Corliss Cross-Compound Condensing? The Straight-Line is much the simplest and cheapest to install, but when the air is not compound, it is also the most expensive to operate in cost per 1,000 ft. of free air per minute, delivered, the unit universally used.

For a comparatively small amount of air on a short contract the Straight Line machine may be selected, but for a large piece of work, using large quantities of air and extending over 2 yr. or more, the Cross-Compound machine, with high pressure steam and condensing, if possible, should be chosen. A steam-driven Straight Line plant consisting of boiler, compressor, air receiver, and the necessary plant piping and fittings of a capacity of 1,200 cu. ft. of free air per minute, will cost erected, everything new, about $8,000.

In a plant for driving a rock tunnel, the contract for which was completed about 6 yr. ago, the cost of a compressed air plant consisting of high pressure tubular boilers 2,100-hp. rating, Corliss Cross-Compound Compressors of 3,400 I.H.P., Intercoolers, Condensers, and Air After Coolers, erected, was about $140,000. This plant delivered about 20,000 cu. ft. of free air per minute at 110 lb.

For use in rough preliminary estimating the cost of installing a new high pressure steam compressor plant may be taken at about $7 per cubic foot of free air per minute.

Cost of Compression.

The cost of furnishing compressed air at 100 lb. pressure, from a steam-driven Cross-Compound Compressor plant, is at present prices, about 5 c. per 1,000 cu. ft. of free air.

At the rock tunnel plant above mentioned, where local conditions were extremely favorable, the claim was made that the cost of delivering compressed air to the main was only 2c. per 1,000 cu. ft. of free air.

The cost of compressing air at 90 lb. pressure, from a small Straight Line plant may run as high as 11 or 12 c. per 1,000 cu. ft. of free air.

Electric Power.

On work where electric power from some neighboring plant is available it is generally possible to obtain such favorable rates for electric current that the cost of plant installation and operation is very materially reduced. The electrically-driven compressor plant may be made so nearly automatic as to require but little attention and avoids the necessity of employing men holding special licenses.

When the work is completed the plant salvage is much greater than in the case of the steam-driven plant.

Generally speaking, in a central plant installation the steam drive should not be considered until the possibilties of obtaining power for the electro drive have been exhausted. In addition to the economy of operation it has the advantage of greater cleanliness, doing away with all the grit and dust of the fire room, and so greatly reducing the depreciation of the machinery and the quantity of lubricating oil.

If not in continuous operation it can be switched off and on at will, with no fires to bank or expensive force to maintain when idle, as is the case with steam.

An advantage in electric operation if the work is spread over a large area is the avoidance of long pipe lines by installing two or more smaller plants at the various points where compressed air is required instead of a single large plant. This may be done without any material increase in the cost of operation in the case of the electric drive.

Under conditions where electric current is unobtainable and serious obstacles to the running of pipe lines arise, it may be advisable to install an electric generating plant at a point convenient to coal and water supply, extending the transmission line to the various distant points where compressed air is required and there installing the electric-driven compressors.

A plant to meet such conditions of a capacity of 7,500 cu. ft. of free air per minute compressed to 100 lb. consisting of 1000-hp. water tube boilers, generators, transmission line, transformers, and motor-driven compressors would cost about $110,000 or about double the cost of a direct steam compression plant.

Ordinarily electric current should be obtainable at a price around 2 c. per horsepower per hour, the price decreasing if the requirements are large. On work where operations are carried on in the daytime only, such electric power contracts are of great advantage to electric lighting companies, as the demand for current comes at the time when lighting consumption is small and so tends to equalize loading conditions. The brake horse-power required to compress 1,000 cu. ft. of air to 100 lb. in an efficient compressor, cooling the air to a constant temperature during compression, is about 135 hp. For lines of mains extending less than a mile from the plant, 90 lb. initial pressure will be sufficient for rock drilling.

Where long pipe lines are necessary a pressure of 100 or 110 lb. should be provided for at the plant, to allow for loss, if rock drills are to be driven at their maximum efficiency. For purposes other than rock drilling the pressure may be reduced considerably.

In running the air supply mains great care must be taken to provide pipes of adequate size and to avoid all leakage at the joints. For all sizes of pipe up to 6 or 8 in., the ordinary screw thread and couplings made up with red or white lead may be used, but for larger sizes of pipe line, special couplings which do not require the pipe to be threaded and do not require that the pipe be laid to an absolute grade should be secured. These latter couplings also act as expansion joints, while on the threaded pipe an occasional swing joine or else an expansion joint may be required on a long line.

Danger From Frost.

Except in the case of very long and exposed pipe lines the danger of freezing in the mains is very slight and in the majority of cases may be ignored. In very large plants this danger is guarded against by installing after-coolers, which condense the moisture in the compressed air before it enters the mains.

If trouble is experienced with freezing at the machines where the power is applied this is easily obviated by installing air re-heaters on the line to these machines. These heaters consist of a coil of pipe in a salamander or other stove or they may be made of a cast iron pot with a grate below and a hood and short stack on top, in which a coal fire is maintained. The cast iron pot is made with a double shell containing an air space through which the compressed air circulates and absorbs sufficient heat to prevent its freezing by expansion in the ports of the machines.

As a temporary expedient a fire may be built around the compressed air main. Ordinarily, unless the duty is very heavy, no trouble will be experienced by freezing.

In all compressor plants frequent attention should be given to the proper draining of the air receiver.

In times like the present, when wide fluctuations are occurring in both the labor and material markets, it is very difficult to determine a fair estimate of costs. The figures that have been given, therefore, must be taken as giving a general idea only and subject to a wide variation on account of changing conditions.

On all contract work the cost of operating machinery is more stable than that of hand labor and therefore should be resorted to by the contractor whenever possible.

New Post Office, Three Rivers, P. Q.

THE new post office building in Three Rivers, P.Q., is situated on the plot of ground known as the Plateau property, fronting on Notre Dame Street and Rue des Casernes, formerly the site of the old British War Office barracks, which property was handed over by the War Office to the government in 1856. The barracks was converted into offices for the Customs, Inland Revenue and St. Maurice Works officials in the year 1880-1-2, but was destroyed by fire in 1908, as was also another building on the same property, which had been originally intended for a customs building, but was converted for post office use when the old barracks building was altered. Consequently, in February, 1913, a contract was entered into for the erection of a new building on the same site.

The structure, which is now completed, consists of a main middle portion 92 ft. long by 78 ft. deep, making in all a frontage of 200 feet. The middle portion, excepting 25 feet in depth at the rear, which is one storey and basement, is three storeys, while the wings are one storey less.

The excavation was made through a sand ridge, which test pits showed to be some 125 feet in depth. Concrete foundations were laid, the material being handled from the mixer by barrows.

The outer walls, which are of common brick, are faced with cut stone and lined with terra cotta, the stone being obtained from limestone quarries at St. Marc des Carrieres. The frame is of steel, encased in concrete; the partitions are terra cotta; the floors, of steel and concrete—covered with hardwood in the offices and tiling in the lobbies; the roof is of steel and concrete, finished in accordance with the Bancoro process, and the dados and stair steps are of marble. Vaults of brick are provided for the various departments.

Heating is by open gravity hot water system, using two series of three furnaces. Lighting is by electricity.

The basement contains the Customs Examining Warehouse, toilet room, workshop, storage room, boiler room and coal room; the ground floor, the post office, the Custom House and the Inland Revenue offices in the middle portion, the right wing and the left wing respectively; the first floor, the public works offices and those of the Harbor Commissioners; and the attic, the caretaker's apartments.

The arrangement of the windows for lighting is especially successful so that in the post office, which is an exceptionally deep room, there is not a dark space even in the corners.

The building was designed by D. Ewart, chief architect, Department of Public Works, and the construction carried out under his instructions. The stone work was constructed under contract with Messrs. Vermette, Macleod & Ferron, of Three Rivers, and the remaining works, under contract with Mr. Joseph Bourque, of Hull. The marble was furnished by Smith Marble and Construction Company, Limited, 145 Van Horne Avenue, Montreal; bricklaying was carried out by J. H. Giroux, St. Olivier Street, Three Rivers; roofing, McFarlane & Douglass, 250 Slater Street, Ottawa; plumbing, Louis Gendron, 39 Bridge Street, Hull; plastering, Jos. Lambert, Three Rivers.

Science in War

Our attention has been drawn by Sir Robert Hadfield to a significant action by the Kaiser in approving the foundation of a trust which is to be entitled "The Kaiser Wilhelm Trust for the Promotion of War Science." The aim of this organization is to further the development of scientific and technical aids in warfare by uniting the scientific and the military forces of the country in co-operative effort. The work is to be carried on by committees dealing with (1) chemical raw materials for the production of materials for munitions; (2) chemical war materials, such as explosives; (3) physics, including telephony and telegraphy; (4) engineering and communications; (5) aeronautics; and (6) the obtaining and preparation of metals. We think it will be generally agreed that the education of German military officers is likely to be more on scientific lines than the education followed in this country, and that consequently if such a movement is desirable in Germany it is still more likely to be necessary in Great Britain. We are well aware that certain similar efforts are already carried on in one way or another by our government departments, but we very much doubt if full advantage is yet being taken of the technical and scientific ability of this country up to the present time.—The Electrician.

Fertilizing Value of Activated Sludge

By Col. George G. Nasmith, Ph. D., C. M. G., and G. P. McKay*

THE most important problem remaining to be solved in the disposal of sewage is probably that of economically dewatering the sludge. Since the discovery of the activated sludge method, the necessity of devising a method of dewatering this new type of sludge has become even more urgent for the reason that activated sludge has marked fertilizing properties, as Bartow and Hatfield have pointed out.

In the activated sludge method of sewage disposal, finely divided air is blown through the sewage. After some time the sludge which settles out is found to possess remarkable properties when agitated with fresh sewage by the same method of aeration. The sludge has become "activated" and when blown in contact with fresh sewage the organic matter present in the latter is rapidly oxidized, practically all the intestinal bacteria destroyed, nitrates elaborated, and a stable effluent formed.

"Activated" sludge, however, like ordinary sludge, contains 95 per cent. of water, and still has to be dewatered before it can be satisfactorily handled.

The treatment of sewage by this method is very promising for if the fertilizing value of the sludge is high, the revenue therefrom would help to pay the cost of dewatering and disposing of the sludge. Furthermore, it is a question of conservation of the first magnitude, for if a fair proportion of the fertilizing value of the excreta from our cities and towns could be saved and turned into the land it would be a great factor towards solving our fertilizer problem, particularly in conserving the supply of humus and nitrates, and increasing the fertility and productivity of the soil.

In December, 1915, a small experimental activated sludge plant was started at the Toronto Main Sewage Disposal Works, Morley Avenue. Dr. Adams and Mr. J. Scott, who at first operated the plant during my absence in France, soon proved that Toronto sludge could be readily activated, and the plant has been in operation ever since. A good deal of preliminary data have been obtained for our own information in case the city of Toronto should ever decide to adopt the method on a large scale. Among other things, we have tested the value of activated sludge as a fertilizer.

Bartow and Hatfield, in some experimental work to determine the value of activated sludge as a fertilizer, made a number of experiments with the growth of wheat in pots. The activated sludge used by them gave the following analysis: Total Nitrogen = 6.3 per cent.; $P_2O_5 = 2.69$ per cent.

By the use of one ton of this sludge per acre, equivalent to 120 lbs. of nitrogen, together with 5 tons of dolomite, ½ ton of bonemeal, and 500 lbs. of potassium sulphate per acre, they obtained a yield of 36 to 37½ bushels of wheat per acre as against 13½ bushels per acre where the equivalent amount of nitrogen had been added in the form of dried blood. The straw also amounted to over two tons per acre as against less than ¾ of a ton of straw per acre where dried blood had been employed as fertilizer.

In further tests as to the value of sludge as a market garden fertilizer, these investigators used plots, each 2 ft. x 3 ft., which were treated with equivalent quantities of sludge and dried blood per acre. They obtained an increase in weight of 40 per cent. in the lettuce and 150 per cent. in the radishes, and the growth was much more rapid in the beds fertilized with activated sludge. They conclude from their experiments "that the nitrogen in 'activated sludge' is in a very valuable form, and that activated sludge is valuable as a fertilizer."

Bartow and Hatfield, in determining the amount of fertilizer to be employed, used as a basis the amount of nitrogen present. For instance, they used in their experiments the quantity of activated sludge and dried blood that would yield 120 lbs. of nitrogen per acre. The amount of phosphate or other ingredients present in the sludge was not considered.

The Value of Fertilizers

Experience has proved that the value of fresh manure as a crop producer is from one-third to two-thirds more effective than rotted manure, because a certain proportion of the nitrogen and other ingredients have been leached out of the latter and lost. Manure haas a greater fertilizing value than would be estimated from the amount of nitrogen, phosphoric acid and potash present. This greater value is due to the large amount of humus present in the manure; humus is not found to any extent in the commercial fertilizers, which are commonly purchased on their nitrogen, phosphoric acid or potash content.

Humus is partly decomposed organic matter, such as decayed leaves. It is found in large quantities in all fertile soils and is probably the most valuable constituent present, because it is not only a source of nitrogen, but it helps to keep the soil moist, loose and well aerated, as well as to provide a medium for the propagation of soil organisms so essential to the growth of plant life.

The chemical constituents in a fertilizer are not the only ones upon which its fertilizing value must be determined. It would be possible to have the same amount of potash, nitrogen and phosphate in two different fertilizers and yet obtain entirely different results upon plant growth. The availability of the food material for the assimilation of the plant is a great factor. Thus ordinary septic sludge is not a good fertilizer for immediate growth of plants, results obtained the first year being poor. But the transformation of the septic sludge taking place in the soil frees the plant food material locked up in this sludge and renders it available, so that it becomes an excellent fertilizer the second year after it has been dug into the soil. The experiences of a number of amateurs in Toronto who have been using ordinary septic sludge for several years in their vegetable and rose gardens, have quite established this fact.

The truest test of fertilizers is not their content of nitrogen, phospate or other chemical, but rather the availability of the chemicals present as food for growing crops and the actual increase in the yield brought about by the fertilizer. Here again the fertilizers must be differentiated according to their ability to produce immediate results. We must determine whether they are available through the growing season, whether they leave a residue of humus and other materials in the soil, and whether they bring about exhaustion of the mineral elements of the soil or not.

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* From the Journal of Industrial and Engineering Chemistry.

Activated sludge, when air-dried, is a dark brown, friable, perfectly inoffensive material with a slightly earthy odor like that of decayed leaves. It consists largely of humus, but contains much more nitrogen, phosphoric acid and potash than does ordinary barnyard manure. Furthermore, it is crowded with millions of the nitrifying type of organisms so essential to plant growth.

For the reasons given above as to the fertilizing value of manure, we have taken this for our standard of comparison and have not compared the fertilizing value of sludge with commercial fertilizers on a nitrogen, phosphoric acid or potash basis.

The real single, final test of any fertilizer or manure is the increase in the yield produced by it when compared with an equivalent amount of barnyard manure.

We selected for our plot experiments a site on very poor, humus-free clay soil, adjacent to our experimental plant. The surface was scraped to free it of any organic matter present, and four inches of water-washed sand were then thoroughly incorporated with the soil to a depth of ten inches. This was done to permit of aeration, to prevent the soil baking in the sun, and to make the soil friable.

Six beds, each 10 ft. x 4 ft., were then laid out and separated from the paths by boards placed edgewise in the ground.

One bed was kept as a control, and no fertilizer added to it. The second was treated with 27 lbs. of air-dried horse manure, and the other four each with 27 lbs. of air-dried sludge (equivalent to 14 ½ tons to the acre). This is summarized below.

Bed	Air-dried Fertilizer	Quantity Used	Total Nitrogen Per cent.	Total P_2O_5 Per cent.
No. 1	None	0	0	0
No. 2	Manure	27 lbs.	1.90	1.00
No. 3	Activated sludge	37 lbs.	2.50	2.46
No. 4	Sludge from old bed	27 lbs.	1.10	0.85
No. 5	Humus—Brush filter	27 lbs.	1.30	1.20
No, 6	Sludge—tanks	27 lbs.	1.21	1.24

On May 18, 1917, the fertilizers were added and thoroughly incorporated with the soil, and on May 21, the seeds were planted in all the beds. Seeds were used except in the case of tomatoes and Spanish onions. A fairly thick planting was made so that plenty of seedlings would be available when thinning out, and a uniform number of strong seedlings of each variety could be left in each bed.

As each row of vegetables was pulled from the several beds at the same time, the complete plants, leaves and all, were placed in bags, labelled and brought to the laboratory. After the removal of adherent earth the product of each bed was weighed; the tops, in the case of root crops, were then taken off and weighed separately and the difference taken as the weight of the root. Notes were also made as to the quality of the crop.

Before weighing, the crops were spread out on the floor in their respective groups and photographed. The photographs, however, gave only a general idea of the difference in size of the various groups because of the fact that the camera had to be tilted, in consequence of which the rows closer to the camera appear larger and the rows farther away smaller than they should be.

The plan adopted worked very well in practice and gave, we think, fair comparative results.

Daily observations were made by the man who looked after the beds, and who was himself a gardener, as to appearance of the various vegetables, temperature, rainfall and cultivation. When he cultivated one bed he cultivated all the beds, if he watered one he watered all, and used the same amount of water, and when he pulled one variety he pulled that variety from all the beds.

In this way we tried to eliminate every factor which might give any advantage to one bed over another, and to remove every influence that might have had any bearing on the growth of the plants except the actual effect of the fertilizers themselves during the course of one season.

The following are synopses of the results obtained:

	Control	Manure	Activated Sludge	Morley Ave. Sludge	N. Toronto Humus	N. Toronto Sludge
Table 1—Early Radishes						
Weight, total—grams	92	455	757	317	582	752
Weight, roots grams	59	350	490	200	417	518
Weight, tops grams	33	105	267	117	165	234
Increase in roots over control —per cent.	..	493	730	239	606	778
Yield per acre—tons	..	5.04	7	...	...	...
Table 2—Head Lettuce						
Weight, total—grams	31	238	484	...	...	...
Increase over control per cent.	..	667	1461	...	...	...
Yields per acre—tons	.:	1.9	3.88	...	...	...
Table 3—Lettuce, Grand Rapids						
Weight, total—grams	75	Missing	524	155	277	248
Increase over control—per cent.	..	Missing	598	106	269	228
Yield per acre—tons	..	Missing	...	...	...	...
Table 4 Beans						
Weight, total—grams	256	296	525	357	377	531
Increase over control—per cent.	..	15.6	105	39.4	47.2	107
Yield per acre—tons	..	1.78	3.16	...	...	...
Table 5 Beets						
Weight, total—grams	79	1796	3437	1160	2012	2945
Weight, roots—Grams	24	730	1737	437	891	1169
Increase over control—per cent.	..	2941	7137	1304	3612	4770
Yield per acre—tons	..	5.85	13.90	...	...	...
Table 6 Late Radishes						
Weight, total—grams	32	75	315	472	285	738
Weight, roots—grams	18	48	179	283	197	452
Increase over control—per cent.	..	139	894	1470	1006	2410
Yield per acre—tons	..	...	...	...	...	...
Table 7—Tomatoes						
Weight, total—grams	29	422	1634	164	553	1184
No. of tomatoes	2	9	15	2	6	13
Average weight of single tomato—grams	14½	47	110	82	89	91
Increase over control—per cent.	..	1355	5603	466	1738	3983
Yield per acre—tons	..	5.07	19.9	...	...	...
Table 8—Carrots						
Weight, total—grams	885	1680	1535	1425	1560	2695
Increase over control—per cent.	..	96	80	66	82	215
Yield per acre—tons	..	20	...	...	...	32.4
Table 9—Onions, Spanish (16 Best)						
Weight, total grams	41	96	280	142	68	327
Increase over control—per cent.	..	134	583	246	64	700
Yield per acre—tons	..	1.2	3.4	...	...	3.9
Table 10—Onions, Red Weatherfield (8 Best)						
Weight, total—grams	67	110	720	239	225	420
Increase over control—per cent.	..	64	974	256	235	527
Yield per acre—tons	..	1.3	8.7	...	...	5.1
Table 11—Onions, Danvers, Yellow Globe (8 Best)						
Weight, total—grams	67	124	232	260	184	169
Increase over control—per cent.	..	85	246	288	174	152
Yield per acre—tons	..	1.5	2.8	...	...	...

Notes on Tables 1 to 11

Table 1—The radishes were planted May 21 and pulled July 5, approximately six weeks later. The same number of radishes was left in each bed.

The yields from the activated sludge and North Toronto sludge were about the same, but 40 per cent. greater than that from the manured bed.

Tables 2 and 3—The two sets of lettuce, pulled July 19, clearly showed the superiority of activated sludge as a fertilizer. These beds yielded double the weight of lettuce produced by the beds fertilized with ordinary manure and other sludges. Activated sludge, therefore, is a particularly good fertilizer for lettuce.

Table 4—The beans, one of the legumes, were pulled August 7, and did not show so wide a variation in the different beds as did the radishes and lettuce. Still, the crops from the beds fertilized with activated sludge

and with North Toronto sludge were 77 per cent. heavier than from the bed fertilized with ordinary horse manure.

Table 5—The beets were pulled August 16. During the period of growth the foliage on the beets in the activated sludge bed was much more luxuriant than that on the beets in any of the other plots. The yield of tops was double that from the beds fertilized with ordinary manure, and the yield of roots 138 per cent. greater. The sludge from North Toronto was considerably behind in this case.

Table 6—The late radishes were not a success, though a large increase over the control was apparent in all cases; they were distorted in shape and in some cases rotted. The yield from the North Toronto sludge plot was greatest, but the sludge from the old beds, which had not been a successful fertilizer up to this time, made a good showing and indicated that aerobic action and nitrification of this sludge had taken place in the earth, rendering this fertilizer available as a plant food.

Table 7—The tomatoes were picked October 2. During the growing season the tomato plant in the activated sludge bed had been most vigorous; the tomatoes had also ripened first on the beds treated with activated sludge and North Toronto sludge. The activated sludge bed gave the greatest number and the greatest total weight of tomatoes. The activated sludge gave a yield of 300 per cent. in excess over that of the manure bed, showing that activated sludge is an ideal fertilizer for tomatoes. The yield from the plot fertilized with North Toronto sludge was considerably behind the activated sludge, though away ahead of the manure plot.

Table 8—The carrots were pulled on October 9. Except in the case of North Toronto sludge, which grew some huge carrots, the yields from the other beds were all much the same as that from the bed fertilized with ordinary manure.

Tables 9, 10 and 11—The onions were pulled October 9, and did not show phenomenal growth. Morley Avenue sludge gave a slightly better results than activated sludge in the case of Danvers Yellow Globe, showing that this sludge had latent fertilizing value. Activated sludge was the best forcer in the case of Red Weatherfield onions, giving an increase in yield of 554 per cent. over the manured crop.

The yield of Spanish onions was practically the same in the case of the beds fertilized with North Toronto sludge and activated sludge, but much greater than that from the manured plots.

In casting about for the reason why the sludge from the North Toronto sedimentation tanks gave us almost as good results as activated sludge, we went back over the method used in its preparation.

The sludge is pumped from the sedimentation tanks into drying beds. The water gradually flows away into the drains beneath, so that in from 2 to 4 weeks the sludge is dry enough to dig out. During this drying period it undergoes anaerobic action underneath the thick black, crust which forms on the surface. Eventually, however, it dries sufficiently for aerobic action to take place in the spongy mass. The sludge is then dug out of the beds and carried away on small dump cars and deposited in long heaps, where it lies exposed to the sun and air until finally removed.

In all probability a series of nitrifying actions somewhat similar to those which occur in activating sludge occur accidentally in this method of drying North Toronto sludge, rendering it suitable for immediate assimilation by plants. It would seem very probable that any sludge dry enough to be spaded would, if thrown into shallow heaps or spread out in layers on the ground, be converted by oxidation and bacterial action from a form not readily assimilable by plants to one readily assimilable by them. The same action would occur when sludge is dug into the earth itself, and presumably more rapidly in a porous soil than in a heavy clay soil. This latter point seems to be evident from results obtained from the anaerobic sludge dug from the old Morley Avenue sludge beds. This sludge made a very poor showing early in the year, but later on in the season appeared to be more readily available for the growth of plant life.

Conclusions

From the foregoing tabulated results it is clearly evident that activated sludge is a most valuable fertilizer. When compared with the standard barnyard manure used by the farmer, our results show the following increases:

Increase in Yield Due to Activated Sludge over Barnyard Manure

	Per cent.
Radishes	40.0
Lettuce	103.3
Beans	77.3
Beets	138.00
Late Radishes	316.0
Tomatoes	291.0
Carrots	No increase
Onions, Spanish	191.0
Weatherfield	554.0
Danvers, Yellow Globe	87.1

From the results obtained by us it seems to be true that crops such as lettuce, where the foliage itself is eaten, or crops like beans, beets or tomatoes, which demand a heavy growth of plant and leaf if the yield of roots or fruit is to be heavy, can be stimulated into very heavy growth by the use of activated sludge. The increase in the yield of onions is also great.

For the growth of lettuce or tomatoes under glass, activated sludge should, therefore, prove to be a most valuable fertilizer. In the case of radishes, though the final weight was not materially greater, the radishes matured much more rapidly, which is just as valuable to the market gardener as if his crop were greater, for the quick growth is what is wanted. The same holds good of lettuce or beets in which the growth was much more rapid than it was with the other fertilizers tested. These points are now being tested by actual experiments under glass.

It should be noted that the amount of air-dried manure added, 14½ tons per acre, is about the maximum amount that could be used to advantage, and, therefore, in all probability the maximum crops capable of being produced by the addition of manure had been produced.

If this is true then the increase in yield due to activated sludge over ordinary barnyard manure is very striking and at once places a high monetary value on this material, for the value of fertilizers must be directly proportional to the crop returns yielded by them.

The Canadian Ingersoll-Rand Company, Ltd., have recently issued a 32 page catalogue, fifteen illustrations, describing the "Ingersoll-Rogler" air compressor. The booklet gives a sketch of the development of the "Ingersoll-Rogler" valve, with particular attention to the application of the valve to large air compressors having direct synchronous motor drive. Other special features of the "Ingersoll-Rogler" compressors described are the rolling mill engine type frames, special intercooler design and clearance controller with automatic maximum load stop.

New Hamilton Office Building

We are reproducing herewith photographs of the Canadian Westinghouse Company's office building, which was recently erected in Hamilton, Ontario. Messrs. Prack and Perrine were the architects and structural engineers. The Pigott-Healy Construction Company of Hamilton, were the contractors for the reinforced concrete work and all masonry—including stone and brick work and interior gypsum partitions throughout.

There were six reinforced concrete slabs to pour each 200 ft. x 50 ft. Combination tile and concrete slabs were used in the design. The building was divided into three panels, running the entire length carried on four lines of concrete beams supported every 20 ft. by square columns.

A large auditorium was provided in one end running two stories and part of another in height, having a clear span of the width of building, arranged through the introduction of steel trusses. A unique feature of these trusses was that they were so designed as to permit of their being incorporated in the ordinary interior dividing walls on the upper floors, and at the same time provide for the various door openings and corridor through the members of the trusses.

Remarkably fast time was made on the structural portion of this work. At the outset a schedule was drawn up lining up a programme for each week. This is nothing new, of course, in construction work, but in this instance the work actually came through on this schedule— the roof slab, the sixth and last, being poured on the very day set out for it.

Some interesting features in connection with this progress were—from the day on which the first slab was ready to pour to the day on which the roof was poured, after deducting for Sundays, holidays, and a few days tie up on structural steel, just 42 working days were put in, or 7 days to each floor. This had to cover the forms, placing of continuous tile for joists, bending and placing of reinforcing steel and the actual pouring. These slabs from bottom of tile to top of concrete were 11 inches.

The cuts here reproduced show the progress of 25 working days from August 1st, to September 1st, taking out Sundays and one holiday. The building has, since Christmas last, been in the hands of interior finishers, painters, tile and marble men. It is now finished and is one of the finest, if not the finest office building occupied by one corporation in this country.

New office building Canadian Westinghouse Co., Hamilton.

Plans for Gouin Highway

Mr. T. Ahearn, president of the Ottawa Motor League, has placed before Sir Lomer Gouin the plans of the proposed Gouin highway, Ottawa County, a distance of 53 miles, and has asked for the support of the Quebec government. The road will start from Hull, and follow the valley of the Gatineau as far as Wakefield. At the latter village the highway will turn west up the Peche Valley, as far as Masham Mills, thence south of Eardley, Luskville, Kingsmere and Chelsea to Hull.

The first unit of the technical school which is planned to be erected in Hamilton, Ont., will cost some $100,000. It will be four storeys high, of reinforced concrete construction, and 60 x 150 feet in plan.

Westinghouse Office Building, July 30, 1917.

Condition of work on Sept. 1, 1917, four weeks later.

Bridges and Viaducts of the World

WHILE there is an almost unlimited number of books on bridges, as well as descriptions in all our technical journals of certain bridges which are termed as "the largest of its kind yet constructed," etc., there are few instances that we can recall where these bridges have been compared as to their dimensions when drawn to the same scale. That this is the only proper method of comparing bridges when the size only is the governing feature is beyond doubt, hence the following interesting article from ""The Engineer" shows how our bridges in America compare with those in Europe. It may be well to state here that bridges in Europe are more heavily designed than in America, and that pin connections are not used in the British Isles. The Quebec bridge, as shown by the drawings on the opposite page, has the longest span, although it is not the longest bridge in the world. The bridges have been classified under two headings, namely, cantilever bridges and steel viaducts. Brief references follow to a number of these bridges.

The bridge over the Firth of Forth is the largest cantilever bridge ever built. The dimensions as shown in the cut, show the enormous size of the structure in comparison with other bridges. It has been said that there is an excess amount of material in the bridge, making the design not as economical as it might have been. Probably the additional factor of safety has been more than justified by the satisfactory service given by the structure. The total length as shown in the cut is 8095 ft., and the clear headway at high water is 150 ft. The trusses are not in parallel planes, but are inclined inwards, being 120 ft, apart at the piers, and only 31 ft. 6 in. at the ends. Most of the compression members are hollow tubes, of a maximum diameter of 12 ft. The whole structure comprises 51,000 tons of steel.

Britannia Bridge.

The Britannia bridge over the Menai straits was built when wrought iron bridge work first came into use. As shown there are two spans of 460 ft. and two of 230 ft. and the overall length is 1,511 ft. Each span consists of two separate tubes, both the top and bottom chords being of cellular construction. The total weight of metal in the bridge is 4,306 tons. In erecting, the two central spans were floated out to their place on pontoons, and the two shore spans were erected on timber falsework.

Blackwell's Island Bridge.

This bridge over the East River near New York City has the next greatest length to the Forth bridge, the total length being 3,724 ft. 6 in. The girders are 60 ft. apart on centres. Nickel steel was used in the tension members and the pins.

The Quebec Bridge.

As shown, the Quebec bridge has a central span of 1,800 ft., the longest in the world. The overall length of the bridge, which includes the two cantilevers and the suspended span, is 2,830 ft. with trusses 88 ft. apart and a total weight of metal of 65,000 tons. It is interesting to note that the K system of web trussing was used instead of the double system of bracing employed in the Forth Bridge, which it is claimed gives greater safety during erection and more economy and rapidity during construction, as fewer temporary members are required. It also simplifies the details and reduces the sections of the diagonal bars, at the same time reducing the secondary stresses. The lateral bracing in the top chords was omitted with the idea of throwing the wind resistance wholly upon the bottom chord, and the eye bars were trussed to support their weight between the main supporting points.

The Thebes Bridge.

The Thebes bridge over the Mississippi River in Illinois consists of five spans of simple girder design with cantilevers at each end. It is criticized as being too squat, and it would have been an improvement had there been five simple spans, all but the middle one being alike, and even this span could have been made simply an enlargement of the others. All the connections are pin connected and the total weight of the steel is 12,000 tons, while the total length of the structure is 2,750 ft. 4 in.

The Poughkeepsie Bridge.

The Poughkeepsie bridge over the Hudson River consists of five spans and two anchor arms. The bridge was originally built for a double line of railway and has been strengthened by inserting another line of trusses midway between the original girders. The whole distance of the seven spans is divided into 95 equal panels of 31 ft. 9¾ in., making the overall length 3,093 ft. 9 in.

Cernavoda Bridge.

This bridge, as shown in the cut, consists essentially of five spans, consisting of simple girders with cantilevers at each end projecting into the adjoining spans, the rest of the structure being made up of suspended spans. The lattice bars forming the web of girders and cantilevers are of the double intersection type, and in this respect are quite different from the American bridges given in the cut. The Cernavoda spans the Danube River in Roumania.

Memphis Bridge.

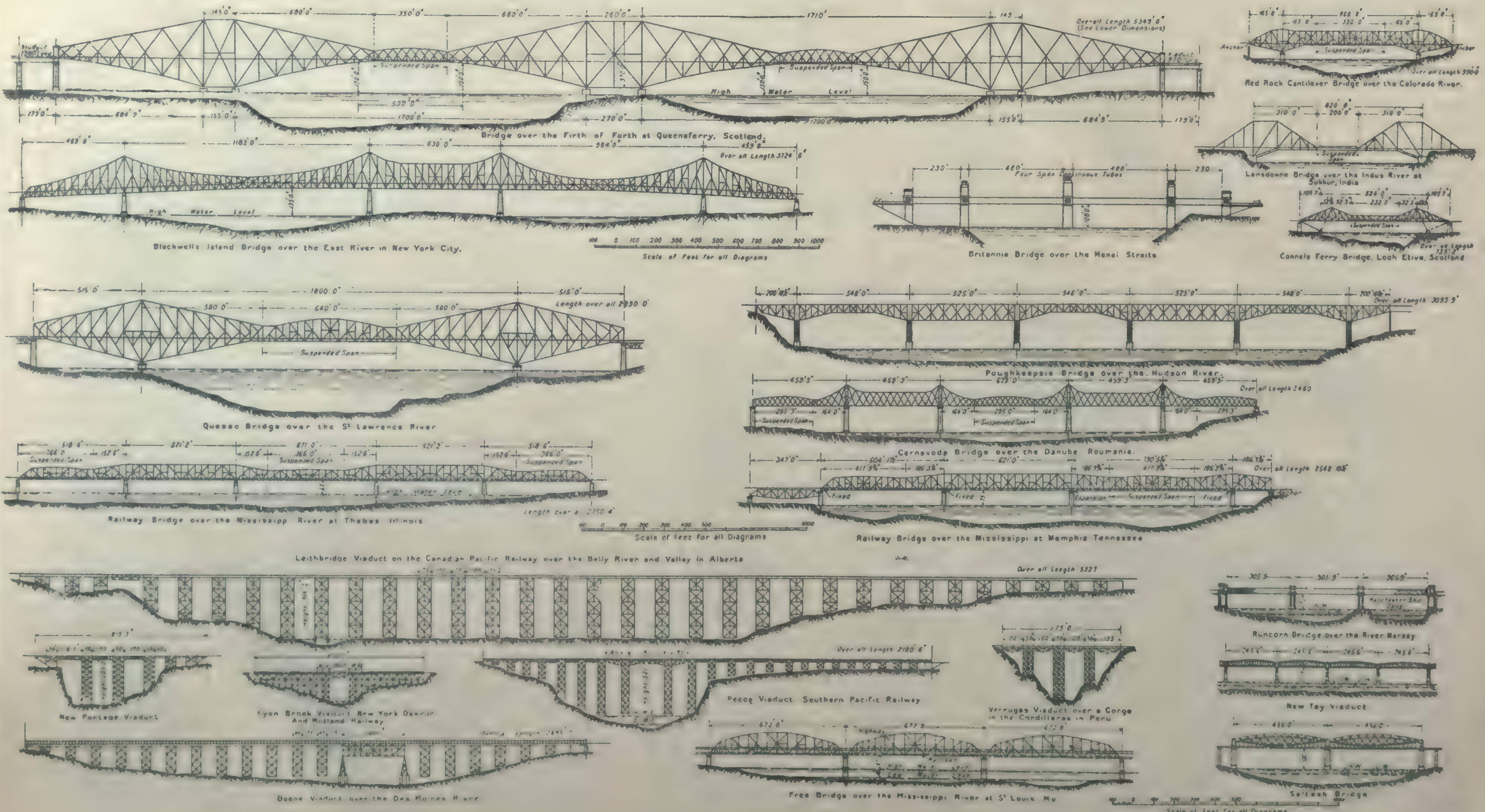
This bridge over the Mississippi is noted for the irregularity of its spans which vary from 347 to 790 ft. 5¼ in. All the joints are pin connected, eye bars are used for tension members, while compression members have the form of channel or double tees. The trusses are 30 ft. apart and the total weight of steel is 6,160 tons, the total length being 2,548 ft. 10½ in.

The sketches of the Lansdowne, Red Rock and Connel Ferry bridges show bridges of less total length but of considerable span.

Steel Viaducts.

The Lethbridge viaduct is probably the largest and heaviest viaduct in the world, and has 12,200 tons of steel in its structure, a length of 5,327 ft. and a height of 314 ft. It is situated in Alberta, Canada, over the Belly River and valley. The design consists of simple plate girders 8 ft. deep placed 16 ft. apart on centres, and of 100 ft. span. The towers are made up of hori-

Biggest Bridges and Viaducts in the World Drawn to Scale for Purposes of Comparison



Bridge over the Firth of Forth at Queensferry, Scotland.

Red Rock Cantilever Bridge over the Colorado River.

Lansdowne Bridge over the Indus River at Sukkur, India

Britannia Bridge over the Menai Straits

Connels Ferry Bridge, Loch Etive, Scotland

Blackwells Island Bridge over the East River in New York City.

Scale of Feet for all Diagrams

Quebec Bridge over the St Lawrence River

Poughkeepsie Bridge over the Hudson River.

Cernavoda Bridge over the Danube, Roumania.

Railway Bridge over the Mississippi River at Thebes Illinois

Scale of Feet for all Diagrams

Railway Bridge over the Mississippi at Memphis Tennessee

Leithbridge Viaduct on the Canadian Pacific Railway over the Belly River and Valley in Alberta

Runcorn Bridge over the River Mersey

New Portage Viaduct

Lyon Brook Viaduct New York Ontario And Midland Railway

Pecos Viaduct Southern Pacific Railway

Verrugas Viaduct over a Gorge in the Cordilleras in Peru

New Tay Viaduct

Boone Viaduct over the Des Moines River

Free Bridge over the Mississippi River at St Louis Mo

Saltash Bridge

Scale of Feet for all Diagrams

Courtesy The Engineer

zontal members and diagonal struts. The erection was done by a steel traveller of 356 tons weight.

The Boone Viaduct.

The Boone viaduct carries the Chicago and Northwestern Railway over the Des Moines river. The towers are 18 in number and have a maximum height of 185 ft. with a width of 45 ft. The spans are 75 ft. each with one exception of 300 ft., while all the girders except those of the larger span, have a uniform depth of 7 ft., there being four lines of main girders of this depth.

The Portage Viaduct.

The Portage viaduct over the Genesee River in New York State, consists of four 50-foot spans, six 50-foot towers,, two spans of 100 ft. and one span of 118 ft., the larger spans being of truss design. This bridge was originally composed of timber Howe trusses, but was burned and replaced with steel.

Verrugas Viaduct.

This viaduct carries the Lima and Oroya railroad over a gorge in the Cordilleras, about 50 miles from Lima, Peru. The viaduct consists of three trestles, each 50 feet wide and made up of 6 verticals braced together, the height being 256 ft. above water level. The Fink system of trussing was adopted. It is said to be the first wrought iron viaduct built in America.

Lyon Brook Viaduct.

The Lyon Brook viaduct carries the New York, Oswego and Midland Ry., and is 820 ft. long. It consists of a series of wrought iron trestles 30 ft. apart, making 24 spans of this dimension and one larger trussed span of 100 ft. The large trusses were carried on trestles entirely of iron.

The Pecos, Free Bridge, Runcorn, Tay, Saltash, are other large viaducts, all of which have their own outstanding details.

Divisional Engineers Given Defined Positions

Consequent on the new policy of concentrating the work of the engineering department of the city of Montreal, the divisional engineers have been given defined positions. Mr. J. H. Valiquette, of the Western division, is now assistant designer toMr. E. Fusey, who is acting chief of the sewers department in the absence of Mr. G. R. McLeod, on war work in the U. S.; Mr. T. Langlois is the assistant engineer of this department. Mr. E. Blanchard, of the Eastern division, has been appointed assistant engineer of the road department. Mr. F. E. Fields, the engineer of the filtration plant, has been appointed assistant to Mr. T. W. Lesage, head of the waterworks department. In future all plans and estimates will be made in the designers' department, in place of this work being done in each department.

A subscriber wishes to obtain a copy of each of the following numbers of the Contract Record, in order to complete his files for binding purposes—Nos. 1 to 19, inclusive, Vol. 22, 1908.

Anyone having a spare copy of any of these issues, will confer a favor by sending them to the Toronto office of the Contract Record.

Railway Contractors Win Suit

In the Superior Court, Montreal, Mr. Justice Mercier has given judgment in two actions by Messrs. O'Brien and Doheny, railway contractors, Montreal, against the Quebec & Saguenay Railway. The plaintiffs were contractors for the portion of the line from St. Joachim to Murray Bay, and suspended work on the construction owing, it was stated, to non-payment of money due for work done. The judge found in favor of the plaintiffs for $970,518.78, being the balance adjudged due for work done and materials supplied in the construction of the portion of the line in question. With interest from September, 1912, the condemnation amounts to over $1,250,000. The court also declared that the plaintiffs were entitled to a privilege upon the railway to the extent of the plus value given by their work, to secure payment of the amount of their claim.

Estimated Cost of Building Work as Indicated by Building Permits in Thirty-five Cities

			May, 1918, compared with May, 1917	
			Increase (*)	Decrease (†)
	May, 1918	May, 1917	Amount	Per Cent.
Nova Scotia	**$ 354,607**	**$ 205,361**	* **$149,246**	* **72.67**
Halifax	298,940	174,311	* 124,629	* 71.49
Sydney	55,667	31,050	* 24,617	* 79.28
New Brunswick	**167,760**	**69,285**	* **98,475**	* **142.13**
Moncton	24,760	52,885	† 28,125	† 53.18
St. John	143,000	16,400	* 126,600	* 771.95
Quebec	**987,267**	**918,062**	* **69.205**	* **7.54**
Montreal-Maisonneuve	658,680	703,154	† 44,474	† 6.32
Quebec	252,562	123,297	* 129,265	* 104.84
Sherbrooke	23,500	23,200	* 300	* 1.29
Three Rivers	12,575	44,330	† 31,755	† 71.63
Westmount	39,950	24,081	* 15,869	* 65.90
Ontario.	**2,314,755**	**1,853,566**	* **456,189**	* **24.57**
Brantford	182,825	9,795	* 173,030	*1,766.51
Fort William	4,930	217,890	† 212,960	† 97.74
Guelph	9,105	26,930	† 17,825	† 66.15
Hamilton	134,800	352,765	† 217,965	† 61.79
Kingston	50,770	18,264	* 32.506	* 17.79
Kitchener	29,660	17,255	* 12,405	* 71.89
London	83,090	95,590	† 12,500	† 13.08
Ottawa	135,475	185,650	† 50,175	† 27.03
Peterborough	54,255	21,018	* 33,237	* 158.13
Port Arthur	525,375	18,557	* 506,818	*2,731.14
Stratford	19,680	34,665	† 14,985	† 43.23
St. Catharines	110,662	74,955	* 35,707	* 47.64
St. Thomas	6,715	12,850	† 6,135	† 47.74
Toronto	877,508	655,427	* 222,081	* 33.88
Windsor	89,905	116,955	† 27,050	† 23.13
Manitoba	**305,054**	**479,280**	† **174,226**	† **36.35**
Brandon	4,354	18,330	† 13,976	† 76.25
Winnipeg	300,700	460,950	† 160,250	† 34.76
Saskatchewan	**314,495**	**112,760**	* **201,735**	* **178.91**
Moose Jaw	211,855	28,425	* 183,430	* 645.31
Regina	53,350	46,025	* 7,325	* 15.91
Saskatoon	49,290	38,310	* 10,980	* 28.66
Alberta	**108,420**	**127,550**	† **19,130**	† **14.99**
Calgary	63,600	53,500	* 10,100	* 18.88
Edmonton	44,820	74,050	† 29,230	† 39.47
British Columbia	**286,595**	**62,200**	* **224,395**	* **360.76**
New Westminster	3,700	9,550	† 5,850	† 61.26
Vancouver	261,845	47,975	* 213,870	* 445.79
Victoria	21,050	4,675	* 16,375	* 350.72
Total (35 cities)	**$4,838,953**	**$3,833,064**	***$1,005,889**	* **26.24**

On May 25th the Southern Canada Power Company, Ltd., formally opened the new sub-station and store at Granby, P.Q. The Company is carrying out a policy of opening show rooms at the principal points on their system for the sale of electrical appliances. Invitations were sent out to the inhabitants of Granby and the district, and were freely responded to. Demonstrations of electrical cooking were given. Several of the directors of the company, with the divisional superintendents and officials, were present. The building is on the main street in the centre of the town. It is constructed of buff brick. The show rooms and the rooms above are devoted to a large display of electrical appliances of all descriptions. The sub-station, of concrete, is located in the rear of the store. This contains three transformers, of 48000-2400 v. and 15 ft. switching panels.

Mainly Constructional

East and West—From Coast to Coast

In order to have the grandstand at the exhibition grounds in Regina finished in time for the summer fair, the city has decided to go ahead and complete the undertaking itself. The pouring of concrete for the ground floor was commenced some time ago.

The town planning board of the County of Halifax, N.S., have intimated their intention, pursuant to the Nova Scotia Town Planning Act, 1915, of applying to the Commissioner of Public Works and Mines of the Province to prepare four town planning schemes, in respect of lands situated in the county.

The mail order building which the T. Eaton Company propose to erect at the corner of Bay and Lake Streets, Toronto, will cost approximately $3,000,000. It will be nine storeys and basement in height and 398 x 223 feet in dimensions. There will be about 88,000 square feet of floor space on each floor.

Leamington, Ont., proposes to construct a new reservoir of 900,000 gallons capacity, also to enlarge the existing one. The total cost of the work and purchase of the land is estimated at $39,000, and the combined capacity of both reservoirs will be 1,065,000, which meets the requirements of the Fire Underwriters.

The contract for the Rock City Tobacco Company's new leaf factory at Leamington, Ont., has been awarded to Mr. W. W. Link. This building will be 220 x 50 feet and will be located on the north side of Ivan Street. For one-half of its length, the construction will be of concrete and the remainder of galvanized iron. Work is to begin at once and is to be completed in three months.

The excavation work for the new government office building in Ottawa, on O'Connor Street, for which Messrs. Bate, McMahon & Company are contractors, has been pushed forward rapidly, with 130 men and 40 teams on the job. The excavation for the main building will be to a depth of 11 ft. below the level of the sidewalk, while for the coal cellar it will be 17 ft., the total number of cubic yards being 12,000.

As a special concession to the Dominion Steel Products Company, which will erect 100 homes in Brantford, Ont., to cost from $3,000 to $5,000, the city council have agreed to levy tax on only half of the building assessment, which is also to be fixed for five years. The school and local improvement taxes, however, will be levied in full. The city will pay the cost of grading the streets in the new subdivision, amounting to $25,000.

With the object of encouraging the building of small apartment houses and the conversion of large residences to similar use, the sub-committee of the Toronto board of control, after consultation with the city architect and fire chief, have recommended to the city council that the residential by-laws be modified with reference to the area bounded by Bloor Street on the north and Parliament Street and Dovercourt Road on the east and west respectively.

In connection with the large mining undertaking of the Granby Consolidated Mining, Smelting & Power Company on Vancouver Island, where, in the vicinity of Cassidy's Landing, near Nanaimo, coal areas recently acquired are now being developed, work is also being proceeded with simultaneously on the $1,000,000 coke plant of the company near Anyox. This plant will be supplied with coal from the company's holdings on Vancouver Island. It will be located at Graves Point, a mile and one-half from the company's great copper smelter. Storage sheds are being erected, the brick shed alone having a floor area of half an acre. Construction of the coal bunkers is also under way. These are 52 ft. wide and 300 ft. long and more than 705,000 ft. of lumber will be used in their construction.

The Canadian Northern Railway will spend in the neighborhood of $2,000,000 in improvements and the construction of new branch lines this year, according to a recent announcement. Almost all of this work will be done on lines west of Port Arthur, and a great deal of it in Saskatchewan and Alberta. An order-in-council has been passed authorizing the company to proceed with the construction of the Medicine Hat-Hanna branch, which serves a well settled and fine grain producing country. The contract for the construction of the section of this branch from Hanna to the Red Deer River, has been awarded to W. A. Dutton, Winnipeg. Construction of the line northwest of Gravelbourg also is contemplated. The line from Battleford to Edmonton and from Edmonton to Edson will be ballasted. New eighty-pound rails will be laid from Munson to Hanna. Second track work will be built from Drumheller westerly to accommodate the growing traffic from the collieries there. In the vicinity of Edmonton work of refilling in the trestle at the west end of the Fort Saskatchewan bridge is commencing. The trestle work will be filled in right up to Edmonton this season. Considerable sums will be expended on station buildings, works and water supply, and general improvements in terminals. Some work also is contemplated on lines east of Winnipeg.

Personals

Mr. T. P. Howard, general manager of the Phoenix Bridge & Iron Works, Montreal, has been elected vice-president of the Canadian Manufacturers' Association. He is now at Washington on the staff of the British War Commission.

Major H. M. Mowat, K.C., M.P. for Parkdale riding, Toronto, speaking before a recent meeting of electors, outlined a bill which he proposes introducing in Parliament in connection with the re-establishment of soldiers in civil life. His suggestion is to form soldiers' settlements near cities, where returned men and their families could live, and the erection, by the government, of power-equipped homes where the men could follow all kinds of employment.

Obituary

Mr. Edward Wakefield, 152 Evelyn Ave., Toronto, of the firm of Wakefield & Company, and one of the pioneer brick manufacturers of Toronto, died from heart failure recently.

Lieut. Harold L. Scully, formerly of Owen Sound, Ont., and who previous to enlistment was on the staff of the Dominion Construction, Toronto, is reported to have died of wounds in France. He was a brother of A. A. Scully, contractor, 123 Bay Street, Toronto.

Trade Publications

Tarvia-KP for Cold Patching—issued by the Barrett Company. This is described as a handy vest-pocket reference booklet showing each step in patching a road with "Tarvia-KP." It is nicely illustrated.

The Harrison Safety Boiler Works, Philadelphia, Penn., manufacturers of the Cochrane lines of equipment, have issued a timely little booklet, "Ways in which the Cochrane Metering Heater Saves Coal." Canadian Allis-Chalmers, Ltd., Toronto, handle this equipment in Canada.

The Buffalo Forge Company, Buffalo, N.Y., have recently issued Section No. 108 of their catalogue, covering stationary forges. It is noted that all forges in this section have been renumbered and in order to avoid confusion an index is included showing both the old and new numbers.

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